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The Commonwealth of Massachusetts

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ANNUAL REPORT

OF THE

METROPOLITAN DISTRICT  
WATER SUPPLY COMMISSION

FOR THE

YEAR ENDING NOVEMBER 30, 1928





Mass. Secretary of the Commonwealth  
Oct. 19, 1937

## REPORT OF THE METROPOLITAN DISTRICT WATER SUPPLY COMMISSION

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*To the Honorable the Senate and House of Representatives of the Commonwealth of  
Massachusetts in General Court assembled.*

The Metropolitan District Water Supply Commission, established under the provisions of Chapter 375 of the Acts of the year 1926, respectfully presents for the year ending November 30, 1928, its

### THIRD ANNUAL REPORT

#### I. ORGANIZATION AND ADMINISTRATION

There was no change in the personnel of the Commission during the year. Davis B. Keniston continued as chairman, and Charles M. Davenport and Joseph H. Soliday as associate commissioners. R. Nelson Molt continued as secretary.

The clerical force of the Commission's office at Boston has remained the same throughout the year. Three special agents were appointed during the year, who have had the care of property acquired by the Commission in the Swift River Valley and along the tunnel line. Real estate purchasing agents and conveyancers have been employed as needed.

The engineering and clerical force of the engineering department averaged 125 employees during the year, with a maximum of 133 in December, 1927.

#### II. ENGINEERING DEPARTMENT

Frank E. Winsor continued as chief engineer, with Karl R. Kennison as designing engineer and Walton H. Sears as mechanical engineer.

Three division engineers are in charge of field divisions as follows: William W. Peabody, Wachusett-Coldbrook Tunnel Division; Richard R. Bradbury, Coldbrook-Swift Tunnel Division; and N. LeRoy Hammond, Swift River Reservoir Division. William W. Peabody reported on July 9, 1928, succeeding Harold W. Horne.

The Commission report with regret the death on May 23, 1928, of Harold W. Horne who, as division engineer, rendered most efficient and faithful service in the location and construction of the Wachusett-Coldbrook Tunnel.

X. H. Goodnough, Chief Engineer of the State Department of Public Health, and J. Waldo Smith, formerly Chief Engineer of the New York Board of Water Supply, continued as consulting engineers. Charles T. Main of Boston was employed from time to time as consulting engineer on mill and water power damages, and Doctor Charles P. Berkey of Columbia University as geologist. Other consultants were employed from time to time as needed.

#### III. OFFICES

The offices of the Commission and of the Chief Engineer continued in the Boston Five Cents Savings Bank Building at 24 School Street, Boston. The three division offices for the Wachusett-Coldbrook Tunnel, the Coldbrook-Swift Tunnel and Swift River Reservoir Divisions continued at Holden Center, Hardwick Center and Enfield, respectively. The office in Framingham for the Southern Sudbury Emergency Supply was discontinued. A laboratory for water analysis has been established.

#### IV. REAL ESTATE

Within the Swift River watershed a total of 1,210 applications by the owners of real estate seeking to dispose to the Commission of a total of 50,119 acres have been received, and of this acreage the Commission has concluded the purchase of, or has under option a total of 26,954 acres. Further details appear in the attached tables.

Land along the route of the Wachusett-Coldbrook tunnel has been acquired, and also, for future sanitary protection, areas in the vicinity of the village of Coldbrook in the towns of Oakham and Barre.

For land taken in fee and for easements taken on account of the Southern Sudbury Emergency Supply settlements were made in all but a few cases.

#### V. TOWN OF PRESCOTT

Under the provisions of Chapter 340 of Acts of 1928, the Commission was required by the Legislature to assume direction of the town government of the town of Prescott during the remainder of the town's corporate existence. The provisions of the Act were accepted by the town of Prescott on June 25, 1928, and within the time required by the Act the Commission duly appointed agents for carrying on the town affairs in the exercise of the authority conferred upon it by the provisions of the Act.

#### VI. PROGRESS

(a) *General.* — The United States War Department on March 19, 1928, notified the Commission that no objection would be interposed to the diversion of the flood waters of the Ware River in excess of 85,000,000 gallons daily between October 15 and June 15 of each year. The application for the diversion of the waters of the Swift River is still pending before the War Department.

On January 9, 1928, the State of Connecticut filed a bill in equity in the United States Supreme Judicial Court against the Commonwealth of Massachusetts, objecting to the diversions from the Ware and Swift rivers as authorized by Chapter 375, Acts of 1926, and Chapter 321, Acts of 1927. Hon. Bentley W. Warren of Boston was appointed by the Attorney-General as Special Assistant Attorney-General in the case.

(b) *Ware River Supply.* — The contracts for the construction of the shafts on the Wachusett-Coldbrook Tunnel were continued until April 30, 1928, when contracts were let for the tunnel construction. 17,331 feet or 3.28 miles of tunnel has been excavated. Shaft 1 at outlet works to the Wachusett Reservoir is partly excavated, and the Ware River intake works near the village of Coldbrook have been partly completed.

(c) *Swift River Supply.* — Real estate and topographical surveys were continued throughout the year. Work was continued on the census of burials in cemeteries, together with records of inscriptions on head stones and monuments. Upon request some bodies have been removed from the reservoir area and have been interred in other cemeteries.

(d) *Southern Sudbury Emergency Supply.* — Construction on the Southern Sudbury Emergency Supply was finished early in the fiscal year.

#### VII. FINANCIAL

The Commission appends hereto a statement of its expenditures and disbursements for the fiscal year, and from the date of its appointment.

#### VIII. OTHER REPORTS

The report of the Chief Engineer is herewith presented. It includes a summary of the information of geological interest, in accordance with the requirements of Section 2 of Chapter 321 of the Acts of 1927.

Respectfully submitted,

DAVIS B. KENISTON,  
CHARLES M. DAVENPORT,  
JOSEPH H. SOLIDAY,

*Metropolitan District Water Supply Commission.*

24 SCHOOL STREET, BOSTON, MASSACHUSETTS,  
January 14, 1929.



# REPORT OF THE CHIEF ENGINEER

*To the Metropolitan District Water Supply Commission.*

GENTLEMEN: — The following is a report of the engineering department for the year ending November 30, 1928.

## ORGANIZATION

In numbers the engineering organization has not materially changed during the year.

Karl R. Kennison, Designing Engineer, continued in charge of all studies in connection with the general plan of the work and the design of structures, the preparation of contract specifications, contract and working drawings.

Walton H. Sears, Mechanical Engineer, continued in charge of the collection of data in connection with mill and water power damages. He assists in the design of work of a mechanical engineering nature and in the preparation of contract specifications.

Three Division Engineers are in charge of field divisions as follows: William W. Peabody, Wachusett-Coldbrook Tunnel Division; Richard R. Bradbury, Coldbrook-Swift Tunnel Division; N. LeRoy Hammond, Swift River Reservoir Division. William W. Peabody reported on July 9, 1928, succeeding Harold W. Horne, who died on May 23, 1928.

Walter Knowles, Assistant Engineer, had charge of the field work for the Southern Sudbury Emergency Supply until that work was completed, when he was transferred to the Swift River Reservoir Division.

Walter H. Junkins, Chemist, has charge of the Springfield Laboratory.

X. H. Goodnough, Chief Engineer, of the State Department of Public Health, and J. Waldo Smith, formerly Chief Engineer of the New York Board of Water Supply, continued as Consulting Engineers. Charles T. Main, consulting engineer, of Boston, has reported on mill and water power damages. Dr. Charles P. Berkey, of Columbia University, has advised on all geological matters. Other experts were employed from time to time as required.

The employees under the direction of the Chief Engineer at the end of the year and of the preceding year were as follows:

PERSONNEL OF ENGINEERING DEPARTMENT					Nov. 30, 1927	Nov. 30, 1928
CLASSIFICATION						
HEADQUARTERS OFFICE, CHIEF ENGINEER AND DESIGNING DIVISION:						
Chief Engineer	.	.	.	.	1	1
Designing Engineer	.	.	.	.	1	1
Mechanical Engineer	.	.	.	.	1	1
Assistant Engineers	.	.	.	.	9	11
Draftsmen	.	.	.	.	6	9
Instrumentmen	.	.	.	.	1	2
Rodmen	.	.	.	.	2	—
Senior Stenographer	.	.	.	.	1	1
Stenographers	.	.	.	.	3	3
Clerks	.	.	.	.	2	2
File Clerk	.	.	.	.	1	1
Office Boy	.	.	.	.	1	1
					29	33
HOLDEN OFFICE, WACHUSETT-COLDBROOK TUNNEL DIVISION:						
Division Engineer	.	.	.	.	1	1
Assistant Engineers	.	.	.	.	5	5
Draftsmen	.	.	.	.	2	2
Instrumentmen	.	.	.	.	4	5
Rodmen	.	.	.	.	10	5
Axemen	.	.	.	.	3	4
Inspectors	.	.	.	.	7	8
Stenographer	.	.	.	.	1	1
					33	31

## CLASSIFICATION

## HARDWICK OFFICE, COLDBROOK-SWIFT TUNNEL DIVISION:

Division Engineer . . . . .	1	1
Assistant Engineers . . . . .	2	5
Draftsmen . . . . .	—	1
Instrumentmen . . . . .	3	1
Rodmen . . . . .	8	8
Axemen . . . . .	2	4
Inspectors . . . . .	—	1
	16	21

## ENFIELD OFFICE, SWIFT RIVER RESERVOIR DIVISION:

Division Engineer . . . . .	1	1
Assistant Engineers . . . . .	7	9
Draftsmen . . . . .	1	3
Instrumentmen . . . . .	5	7
Rodmen . . . . .	16	11
Axemen . . . . .	6	7
Inspectors . . . . .	1	1
Clerk . . . . .	1	—
	38	39

## FRAMINGHAM OFFICE, SOUTHERN SUDBURY EMERGENCY SUPPLY:

Assistant Engineers . . . . .	4	—
Instrumentmen . . . . .	3	—
Rodmen . . . . .	4	—
Axemen . . . . .	2	—
Inspectors . . . . .	4	—
	17	—

## SPRINGFIELD LABORATORY:

Chemist . . . . .	—	1
Assistant Engineer . . . . .	—	1
Assistant Chemist . . . . .	—	1
Instrument men . . . . .	—	1
Boatman . . . . .	—	1
Clerk . . . . .	—	1
	—	6

Total Engineering Force . . . . . 133 130

The maximum force during the year was 133, during the weeks ending December 3 and 10, 1927. The minimum force was 119, during several weeks in April, May and July, 1928. The average force for the year was 125.

## OFFICES

The office of the Chief Engineer and Designing Division was continued in the Boston Five Cents Savings Bank Building at 24 School Street, Boston. The field office of the Wachusett-Coldbrook Tunnel Division was continued at Washburn Hall, Holden Center. The field office of the Coldbrook-Swift Tunnel Division was continued in the brick building formerly used as a school at Hardwick Center. The field office of the Swift River Reservoir Division was continued in the Felton Block at Enfield (with additional drafting room space in Bartlett Block). The field office for the Southern Sudbury Emergency Supply at 5 Hollis Street, Framingham, was discontinued on February 29, 1928. A laboratory for water analyses was established on July 23, 1928, in the Markarian Building, 175 State Street, Springfield.

## HEADQUARTERS OFFICE

*Summary of the Year's Work*

*Applications for Diversions from Ware and Swift Rivers.* — Studies of the effect of the proposed diversions for the Metropolitan District of waters from the Ware and Swift rivers upon the flow of the Connecticut River were continued. The War Department under date of March 19, 1928, advised the Commission that "no objection will be interposed by the War Department to the diversion of the flood waters of the Ware River exceeding 85,000,000 gallons per day for the period October 15 to June 15 each year."

The Commission's application to divert the waters of the Swift River as authorized by Chapter 321, Acts of 1927, is still pending.



*Diversion Damages.* — Hydrographic data were gathered at various plants which may be affected by the proposed diversions and elsewhere, for use in connection with the determination of diversion damages.

*Real Estate.* — In the Swift River Reservoir area, 17,917 acres were offered for sale by their owners this year, making a total so offered to date of 50,119 acres. Reports and recommendations with respect to purchasing these various parcels were submitted to the Commission. Preliminary studies were continued of highway and cemetery relocations.

One taking plan covering 11 parcels of land along a portion of the Wachusett-Coldbrook Tunnel was prepared and filed during the year.

*Contracts and Specifications.* — Contract 14, for the construction of the East Portion of the Wachusett-Coldbrook Tunnel in the towns of West Boylston, Holden and Rutland, and Contract 17, for the construction of the West Portion of the Wachusett-Coldbrook Tunnel in the towns of Rutland, Oakham and Barre, were executed on April 30, 1928. Contract 14 includes Shaft 1, 221 feet deep, at the outlet into Wachusett Reservoir, and Contract 17 includes Shaft 8, 253 feet deep, at the Ware River Intake. The total length of the tunnel in these two contracts, including short portions excavated near the bottom of six construction shafts under other contracts, is about 14 miles. As the work progressed, working drawings were prepared and issued as required.

Plans and specifications were prepared for furnishing cast iron shaft lining plates and other special castings to be incorporated in the construction of the Ware River Intake Works at Shaft 8.

Plans and specifications are in progress for the diversion dam and gatehouse of the Ware River Intake Works and studies were made for the extension of the tunnel westerly from Coldbrook to the proposed Swift River Reservoir.

*Inspection and Tests.* — E. L. Conwell & Company of Philadelphia continued to make tests of cement for use on the work. As the demand for cement increased with the progress of Contracts 14 and 17, bins were set aside at the cement mills for use on these contracts. Bin sampling was then substituted for car sampling. Four bins, aggregating 27,000 barrels of cement, were tested. As each carload is shipped, an inspector certifies that the contents are from an approved bin.

*Hydrographic Data.* — The gaging station on the Ware River at Coldbrook which was established in co-operation with the United States Geological Survey was completed and put into operation January 28, 1928. During the year measurements of flow were made to establish a rating curve, and the daily record of stream flow was computed.

A gaging station was established on the Chicopee River at Bircham Bend at the plant of the United Electric Light Company of Springfield in co-operation with the same company. A recording gage was installed by the Commission and put into operation on August 4, 1928. Field work was done to determine the rating curves for the discharge of the wheels and the dam, which work is still in progress.

A stream gaging station was established by the United States Geological Survey on the Connecticut River at Thompsonville, Connecticut, "Enfield Dam," July 15, 1928, in which work the Commission was one of the co-operating parties. At this station, current meter measurements were made in co-operation with the United States Geological Survey to determine the rating curve of the dam and the canal. Staff gages were established on the Connecticut River from the Massachusetts state line to Holyoke, and various current meter measurements were made at points on the Swift, Ware, Quaboag and Chicopee rivers.

### *Design of Structures*

*Shaft 1. Outlet to Wachusett Reservoir.* — Further studies of the tunnel discharge under various conditions out of Shaft 1 and through the channel to the Wachusett Reservoir were made in connection with the preparation of working drawings for Contract 14. The final design provides a weir for measurement of all flows too small to be measured by the large Venturi meter to be imbedded in the lining of the shaft itself.

Studies were also made of the superstructure and power plant and equipment that may later be provided at this location, also of the valves that must be in-

stalled as soon as the Swift River Reservoir is ready for filling, in order to turn the Ware flood flows westerly, when desired, into the Swift River Reservoir instead of allowing them to flow easterly into Wachusett Reservoir.

Due to an exceptionally heavy summer and autumn rainfall in 1927 and a consequent unforeseen rise in the Wachusett Reservoir in the latter part of 1927 which was maintained well into 1928, the sanitary works which the tunnel contractor was required to provide at Shaft 1 were redesigned and built to provide for operation on a higher level.

*Shaft 8. Ware River Intake Works.*—Studies of the diversion works required at Shaft 8 were continued and detailed designs are in progress for the complete intake works that will be required for the Ware River at Coldbrook.

The flow down the river will be measured and recorded by a 52" x 26" Venturi meter, to the limit of its capacity. An adjustable orifice or weir will be used to limit the discharge of the river to the required 85 million gallons daily. Flood flows in excess of this limit will be automatically discharged into the tunnel through a battery of siphon spillways with crest sections varying in size from 24" pipe to 9 feet long x 3 feet 3 inches high. Floods up to about 700 cubic feet per second will be measured through a 120" x 60" Venturi meter, and greater floods will automatically discharge freely into the shaft up to the maximum capacity of the tunnel, estimated at 2,800 cubic feet per second when discharging into both Wachusett and Swift River Reservoirs.

*Southern Sudbury Emergency Supply.*—The construction of the Southern Sudbury Emergency Supply was completed and the pipe lines tested for capacity during the year. Tests of these lines confirmed the information relative to capacities of the various lines given in the Annual Report of the Chief Engineer for the year ending November 30, 1927.

Record drawings covering the construction of the Southern Sudbury Emergency Supply were prepared and turned over to the Chief Engineer of the Water Division of the Metropolitan District Commission.

#### WACHUSETT-COLDBROOK TUNNEL DIVISION — HOLDEN OFFICE

The Wachusett-Coldbrook Tunnel Division has charge of the construction of the Wachusett-Coldbrook Tunnel, with the exception of Shaft 8. The division office was continued at Holden Center and field offices were provided at each shaft where work was in progress under Contracts 14 and 17.

Following the death of Harold W. Horne on May 23 and until William W. Peabody reported on July 9 to succeed him as Division Engineer, the work of the Division was in charge of Richard R. Bradbury, the Division Engineer of the Coldbrook-Swift Tunnel Division.

#### *Office Work*

Topographic notes were reduced and plotted, real estate surveys computed and plotted and estimates prepared. Studies were made of geologic formations as revealed by shaft and tunnel excavation, of the character of materials available for concrete aggregates and of sands available for filters. Records of contractor's equipment on Contracts 14 and 17, including camps and appurtenances were kept.

Compressive tests were made on concrete test cylinders cast at the outlet works at Shaft 1. These tests were made at the Worcester Polytechnic Institute.

#### *Field Work*

In the vicinity of Coldbrook, 52 parcels of land totalling 635 acres were surveyed. Additional real estate surveys were made in Rutland and Holden. Topographic surveys totalling about 600 acres were made at Shaft 1 and along the Ware River from Coldbrook to a point approximately two miles north. A line of levels was run from the precise bench at Shaft 6 to North Rutland. A total of 33 property bounds were set. Lines and grades were given for construction work on the Wachusett-Coldbrook Tunnel under Contracts 4, 8, 12, 14 and 17.

Beginning September 21, 1928, color observations were made weekly at a number of stations along the Ware River and tributary streams. Samples of the drinking water used at the different contractor's camps and of the effluent from the



sewage disposal plants at various institutions in Rutland were taken by the State Department of Health, with the co-operation of this office, for analysis by that department.

### Progress of Contracts

Continuing under an agreement dated July 15, 1927, with the Pennsylvania Drilling Company, for making core borings, six holes totalling about 290 feet were drilled during the year. Five of these were for location studies of the proposed Coldbrook-Swift Tunnel, four holes in Barre along the line just west of Shaft 8 and one in Hardwick for locating Shaft 10. The sixth hole was placed at the site of the diversion dam at Shaft 8 to obtain additional information regarding earth cover and rock conditions at this location. These six holes totalled 206.5 feet in earth and 84.0 feet in ledge, making the total under this agreement 2,176.2 feet in earth and 552.5 feet in ledge.

Two gas-driven drilling machines were used on this work. Representative samples of the overburden were obtained at intervals with the aid of a dry sampling spoon and a sample or core of the underlying rock was obtained by drilling to a suitable depth with a black diamond-studded bit.

The work under this agreement was completed December 19, 1927.

CONTRACT 4. — Contract 4 for sinking Shaft 5 (656 feet deep) of the Wachusett-Coldbrook Tunnel was awarded to James J. Coughlan & Sons, Inc., of Boston, Mass., on March 28, 1927. The work was completed on June 12, 1928, the total value thereof being \$290,581.99.

At the beginning of the year, this shaft had been excavated to a point 8 feet above the tunnel invert and 633 linear feet of shaft lining had been completed. Early in the year, tunnel excavation was started, maintaining a top heading of about one-half the tunnel cross section 10 feet to 20 feet in advance of the bench excavation. The average weekly progress on tunnel excavation easterly was 29.1 feet and westerly 30.3 feet, the maximum progress being in the week ending March 17, 1928, when 45 feet was excavated in the east section and 51 feet in the west section. No timbering was required. At the termination of the contract the excavation had reached an average distance of 670.5 feet east of the shaft and 696.5 feet west of the shaft, making a total of 1,367 feet. At the conclusion of the contract, pumpage was at the rate of 32 gallons per minute.

The work done and materials furnished under the principal items of this contract (Shaft 5) were as follows:

	During Year ending Nov. 30, 1928	Total
Earth excavation (19 ft.)	—	177.2 cu. yds.
Rock excavation in shaft (637 ft.) and tunnel (1,345 ft.)	9,310.7 cu. yds.	14,336.7 cu. yds.
Drainage in shaft and tunnel	1,693.1 lin. ft.	2,017.1 lin. ft.
Forms for shaft lining	—	633 lin. ft.
Concrete for shaft lining (633 ft.)	—	1,428.2 cu. yds.
Portland cement	—	1,754 bbls.

The contractor's total force averaged 76 men.

CONTRACT 8. — Contract 8 for sinking Shafts 6 and 7 of the Wachusett-Coldbrook Tunnel was awarded to James J. Coughlan & Sons, Inc., of Boston, Mass., on May 24, 1927. The top heading and bench method was employed in driving tunnel from both shafts under this contract. The work was completed on June 12, 1928, the total value thereof being \$456,784.26.

Shaft 6 (432 feet deep). — At the beginning of the year Shaft 6 had already been excavated to a point 6 feet above the tunnel invert and the concrete lining had been completed. Shaft excavation was finished early in the year and tunnel excavation started at both east and west headings. The average weekly progress on tunnel excavation was 29.2 feet in an easterly, and 29.1 feet in a westerly direction. The maximum progress of 47 feet easterly and 50.5 feet westerly was for the week ending February 11, 1928. At the termination of the contract the excavation had reached an average distance of 671 feet east and 669 feet west of the shaft, totalling 1,340 feet. No timbering was required. At the conclusion of the contract, pumpage was about 18 gallons per minute.



The work done and materials furnished under the principal items of the contract at Shaft 6 were as follows:

	During Year ending Nov. 30, 1928	Total
Earth excavation (29 ft.)	—	273.3 cu. yds.
Rock excavation in shaft (403 ft.) and tunnel (1,318 ft.)	9,166 cu. yds.	12,340 cu. yds.
Drainage in shaft and tunnel	1,554.2 lin. ft.	1,765.2 lin. ft.
Forms for concrete lining	—	413 lin. ft.
Concrete shaft lining (413 ft.)	—	960 cu. yds.
Portland cement	—	1,054 bbls.

The contractor's total force averaged 66 men.

*Shaft 7* (411 feet deep). — At the beginning of the year Shaft 7 had been completely excavated and lined and the tunnel had been excavated for a distance of 123 feet easterly and 128 feet westerly. The average weekly progress in both easterly and westerly directions was 33.2 feet with a maximum of 51.5 feet at the east heading and 51 feet at the west heading for the week ending March 24, 1928. At the end of the contract an average distance of 861 feet was reached in each direction, making a total of 1,722 feet, 1,471 of which was done this year. No timbering was required. The pumpage at the conclusion of the contract was about 18 gallons per minute.

The work done and materials furnished under the principal items of the contract at Shaft 7 were as follows:

	During Year ending Nov. 30, 1928	Total
Earth excavation (24 ft.)	—	230.9 cu. yds.
Rock excavation in shaft (387 ft.) and tunnel (1,700 ft.)	9,881 cu. yds.	14,650 cu. yds.
Drainage in shaft and tunnel	1,802.3 lin. ft.	2,126.3 lin. ft.
Forms for concrete lining	—	392 lin. ft.
Concrete shaft lining (393 ft.)	—	908 cu. yds.
Portland cement	—	1,105 bbls.

The contractor's total force averaged 67 men.

**CONTRACT 10.** — Contract 10 with the New England Power Company, for constructing, maintaining and operating a 22,000-volt transmission line along the Wachusett-Coldbrook Tunnel line, was in force throughout the year. The contractor employed an average of seven men. Electric power was purchased from this company by the contractors on Contracts 4, 8, 12, 14 and 17.

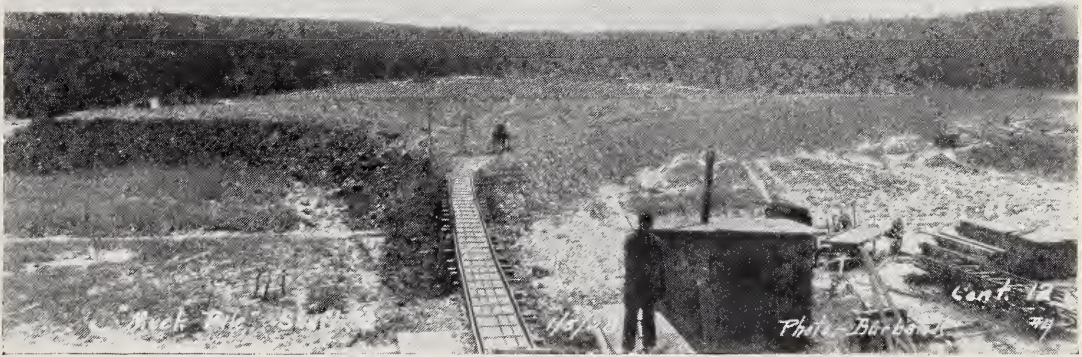
The cost of operation and maintenance for the twelve months ending November 30, 1928, was \$8,166.86.

**CONTRACT 12.** — Contract 12, with the Dravo Contracting Company of Pittsburgh, Pa., for sinking Shafts 2, 3 and 4 of the Wachusett-Coldbrook Tunnel, was modified on October 25, 1927, and January 3, 1928, to provide for extending the tunnel beyond the limits set forth in the contract. The total length of tunnel excavated under this contract was 3,809.5 feet, of which 3,366.5 feet was done this year. The top heading and bench method of tunnelling was employed at all three shafts. The work was completed on June 12, 1928, the total value thereof being \$632,727.44.

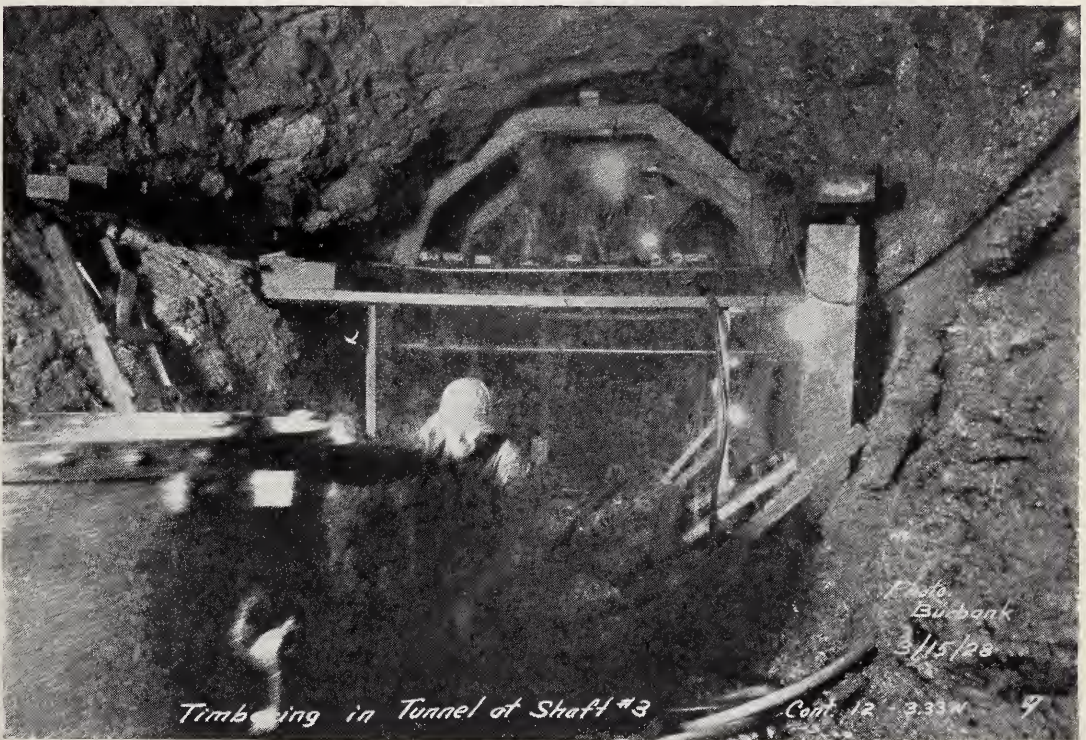
*Shaft 2* (313 feet deep). — At the beginning of the year, the excavation and lining at Shaft 2 had been completed and the tunnel had been excavated for a distance of 213 feet easterly and 230 feet westerly. The average weekly excavation was 29.4 feet easterly and 30.5 feet westerly with a maximum weekly progress of 43 feet easterly and 34 feet westerly during the week ending April 21, 1928. At the termination of the contract, the excavation had reached an average distance of 867.5 feet east and 902.5 feet west of the shaft, making a total of 1,770 feet, 1,327 feet of which was done this year. No timbering was required. At the conclusion of the contract, pumpage was at the rate of about 64 gallons per minute.

The work done and materials furnished under the principal items of the contract at Shaft 2 were as follows:





CONTRACT 12. — Spoil Bank at Shaft 2.



CONTRACT 12. — Timbering in the Tunnel at Shaft 3.





	During Year ending Nov. 30, 1928	Total
Earth excavation (25 ft.)	—	231.8 cu. yds.
Rock excavation in shaft (289 ft.) and tunnel (1,748 ft.)	8,998.3 cu. yds.	14,327.3 cu. yds.
Drainage in shaft and tunnel	1,707.9 lin. ft.	2,076.9 lin. ft.
Forms for concrete lining	—	291.1 lin. ft.
Concrete shaft lining (296 ft.)	—	678.2 cu. yds.
Portland cement	—	920 bbls.

The contractor's total force averaged 54 men.

*Shaft 3* (339 feet deep). — At the beginning of the year Shaft 3 had been excavated to within 4 feet of the tunnel invert. The shaft was completed and tunnel excavation started early in December. A weekly average of 26.9 feet easterly and 24.3 feet westerly was excavated, with a maximum progress of 47 feet easterly and 44.5 feet westerly in the week ending April 21, 1928. At the completion of the contract, the excavation had reached an average distance of 630 feet east and 566 feet west of the shaft, a total of 1,196 feet.

Due to some disintegration and scaling of the rock in portions of the tunnel roof, permanent timber was erected in four short sections, two of which, totalling 148 feet, were east of the shaft and two, totalling 176 feet, west of the shaft. Temporary timbering for a distance of 33 feet in the tunnel east of the shaft and 34 feet west of the shaft, was also erected. Approximately 162 cubic yards of dry packing was placed above the permanent timbering. At the completion of the contract, pumpage was at the rate of about 210 gallons per minute.

The work done and materials furnished under the principal items of the contract at Shaft 3 were as follows:

	During Year ending Nov. 30, 1928	Total
Earth excavation (61 ft.)	—	693.4 cu. yds.
Rock excavation in shaft (278 ft.) and tunnel (1,174 ft.)	7,954.3 cu. yds.	10,348.3 cu. yds.
Drainage in shaft and tunnel	1,362.6 lin. ft.	1,528.6 lin. ft.
Forms for concrete lining	0.6 lin. ft.	327.6 lin. ft.
Concrete shaft lining (328 ft.)	—	955.3 cu. yds.
Portland cement	—	1,258½ bbls.
Timber (391 ft.)	48.33 M ft. B. M.	48.33 M ft. B. M.
Dry packing	161.7 cu. yds.	161.7 cu. yds.

The contractor's total force averaged 58 men.

*Shaft 4* (458 feet deep). — At the beginning of the year Shaft 4 had been excavated to a point 17 feet above the invert of the tunnel. The shaft was completed and weekly tunnel excavation progress thereafter averaged 22.2 feet easterly and 20.5 feet westerly, with a maximum progress of 33 feet easterly and 29.5 feet westerly during the week ending March 24, 1928. At the end of the contract the excavation had reached an average distance of 442 feet east and 401.5 feet west of the shaft, or a total of 843.5 feet. At the conclusion of the contract the pumpage was about 110 gallons per minute.

The work done and materials furnished under the principal items of the contract at Shaft 4 were as follows:

	During Year ending Nov. 30, 1928	Total
Earth excavation (23 ft.)	—	214.9 cu. yds.
Rock excavation in shaft (435 ft.) and tunnel (821.5 ft.)	5,876.3 cu. yds.	9,192.3 cu. yds.
Drainage in shaft and tunnel	1,074.7 lin. ft.	1,294.7 lin. ft.
Forms for concrete lining	0.6 lin. ft.	441.6 lin. ft.
Concrete shaft lining (442 ft.)	—	1,021.6 cu. yds.
Portland cement	130 bbls.	1,544 bbls.
Drilling holes in rock	581 ft.	945 ft.
Grout	22.9 cu. yds.	36.9 cu. yds.

The contractor's total force averaged 51 men.

WACHUSETT-COLDBROOK TUNNEL CONTRACTS. — Both Contracts 14 and 17 were assigned, upon execution on April 30, 1928, to the West Construction Co., a

Massachusetts corporation organized by the contractors for the prosecution of the work, and operations were commenced early in May. General headquarters were established at West Rutland, in several buildings previously purchased by the Commission from the Rutland Worsted Co. The Wachusett-Coldbrook Tunnel Division has supervision of construction of both of these contracts except the work at Shaft 8, which is under the supervision of the Coldbrook-Swift Tunnel Division. Power for these contracts is taken from the electrical transmission line connecting all shafts constructed and maintained by the Commission under Contract 10, for which power the contractor pays the New England Power Company  $1\frac{1}{2}$  cents per kilowatt hour measured at 22,000 volts, as provided under the terms of said Contract 10. Pumping at Shafts 2, 3 and 4, was taken over from the former contractor on May 7. Shaft timbering for and the installation of cages in the completed shafts was begun promptly thereafter. Cross timbers consisted of one 6" x 10" and two 4" x 10" timbers spaced 10' on centers and so placed as to form two 8'-4" x 4'-10" clear openings to accommodate the cages. Cage guides were of 4" x 6" timbers. The contractor retained four local physicians to render medical and surgical attendance to employees and perform other services as specified in the contract.

CONTRACT 14. — Contract 14, including the east portion of the Wachusett-Coldbrook Tunnel in West Boylston, Holden and Rutland, and the construction of Shaft 1 with Outlet Works to Wachusett Reservoir, was executed on April 30, 1928, with Johnston P. Porter, R. Frederick Porter and Lawrence T. Porter, individually and as co-partners doing business under the firm name and style of J. P. Porter & Sons, who assigned the contract to the West Construction Co. Shafts 2, 3 and 4 were sunk to tunnel grade and 3,809 feet of tunnel excavated previously under Contract 12, leaving about 29,895 feet of tunnel and Shaft 1, 221 feet deep, to be driven under Contract 14. In order to avoid any possibility of contamination of the water supply in Wachusett Reservoir, this contract also included the construction of sanitary and drainage structures at each shaft. Chemical toilets were used for human excreta and the garbage was incinerated. During the year the excavation and preliminary lining of Shaft 1 were about three quarters completed, nearly half the masonry in the Outlet Channel walls was placed and a total length of 2,648 feet of tunnel was excavated. The value of the work done on this contract to November 15, the date of the latest estimate, was \$268,500.15, of which 90 per cent was approved for payment.

Shaft 1. — Operations were started at Shaft 1 during the week ending June 2, with the construction of camp buildings near the shaft. The camp site is located about 350 feet south of the shaft and at a considerably higher elevation. The camp buildings include dining room and kitchen, two bunk houses, an emergency hospital, cook's quarters, drying house and storeroom. Wash water and other liquid wastes were disposed of in septic tanks, the effluent leeching into porous ground located in the drainage area of the settling basin. The buildings at the shaft include a general office, engineers' office, compressor house, garage, blacksmith shop and cement shed. The construction of the sanitary works was begun early in July. The embankment of the settling basin was constructed of earth with a compacted soil core, most of the material being obtained from excavations for the shaft and outlet channel. All water pumped from the shaft and other excavations flows into the settling basin. Chlorinating apparatus for treating the overflow from the settling basin was completed ready for operation on July 20.

The shaft excavation was taken out to natural slopes to a depth of 21 feet when a crib of 12" x 12" timbers surrounded by steel sheet piling was erected and sunk to rock as the excavation progressed, the sheeting being driven with a steam hammer. At the end of the year 129 feet of shaft excavation in rock had been driven, the total depth including earth being 159 feet. The preliminary concrete lining in the shaft was placed behind wooden forms made up in 6-foot units. Natural sand and gravel, delivered by motor trucks, was used for concrete. The pumpage from the shaft averaged about 25 gallons per minute until a depth of about 135 feet was reached, when it increased to 90 gallons per minute.

Excavation for the outlet channel was carried on in connection with the shaft



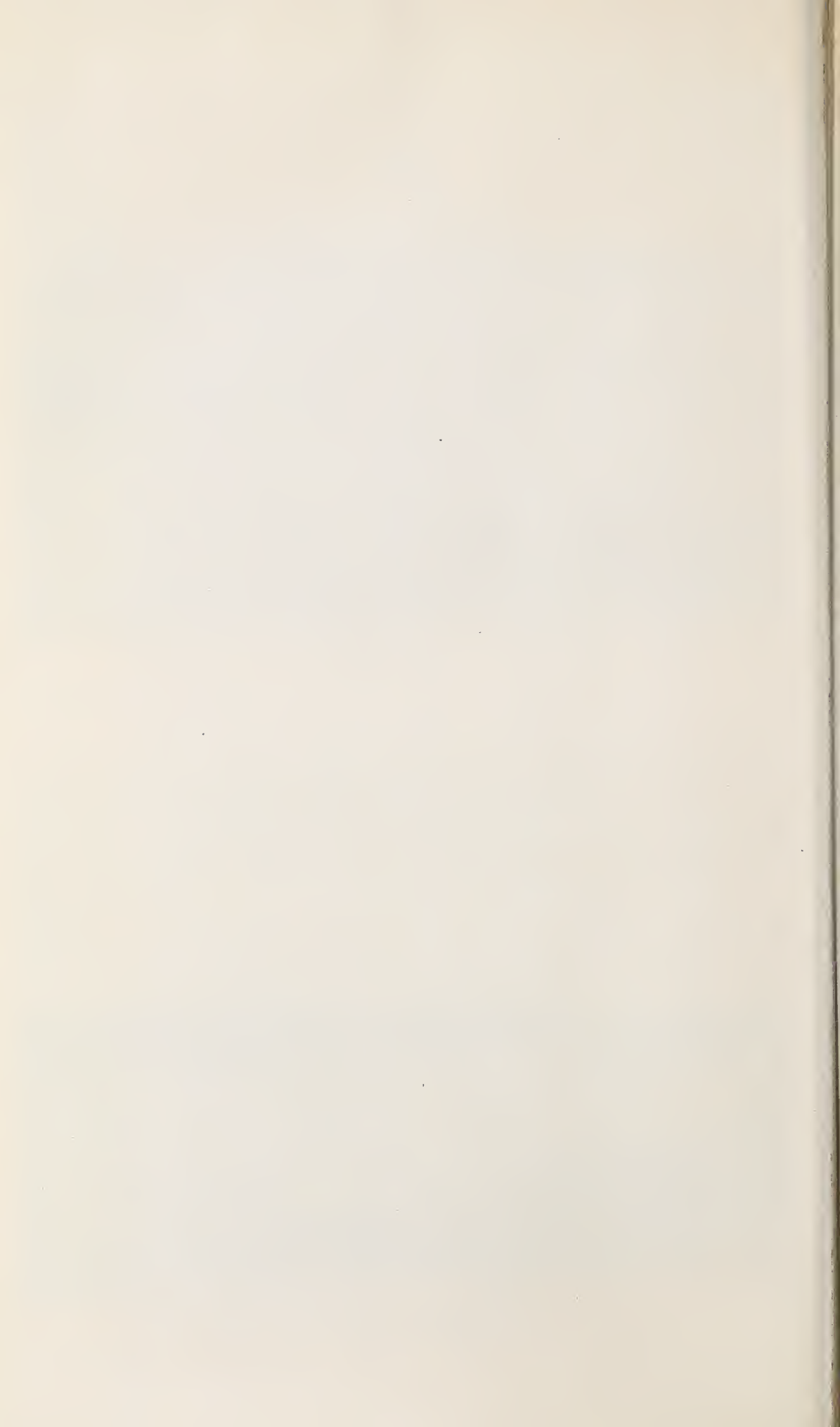


CONTRACT 14. — Shaft 1 and Outlet Channel into Wachusett Reservoir.



CONTRACT 14. — Settling Basin for Camp Sanitary Works, Shaft 2.





excavation and the entire north retaining wall was built up to or above Elevation 389. The south wall was started.

#### MISCELLANEOUS CONSTRUCTION DATA, SHAFT 1

Total depth of shaft	.	.	.	.	.	.	.	.	.	221 feet
Depth of earth	.	.	.	.	.	.	.	.	.	30 feet
Work begun	.	.	.	.	.	.	.	.	June 1, 1928	
Earth excavation completed	.	.	.	.	.	.	.	.	Sept. 8, 1928	
Rock excavation begun	.	.	.	.	.	.	.	.	Sept. 10, 1928	
Maximum depth of rock excavated in one week	.	.	.	.	.	.	.	.	20 feet	
First concrete lining placed	.	.	.	.	.	.	.	.	Sept. 17, 1928	

The principal items of plant at Shaft 1 were as follows:

- 1 Air compressor, 642 cu. ft. per min. capacity, run by 125 H. P. motor.
- 1 14'-0" x 4'-6" air receiver tank.
- 1 Gasoline driven drag line excavator with caterpillar traction.
- 1 3½-ton gasoline locomotive, 36-inch gauge, cars, etc.
- 1 Concrete mixer, capacity ½ yard, 7½ H. P. motor.
- 1 Steam hoist and boiler.
- 1 Derrick with 50-foot boom.
- 5 Pumps, the largest of which has a rated capacity of 300 gals. per min. under 275-foot head, driven by 40 H. P. motor.
- Drill equipment, machine shop equipment, etc.

*Shaft 2.* — Work at Shaft 2 under Contract 14 was started on May 14, 1928, with the construction of camp and plant buildings comprising 2 bunk houses, an emergency hospital, foremen's and mechanic's quarters, cooks' quarters, dining room, kitchen and storeroom, general office, engineers' office, charging station, blacksmith shop, machine shop, warehouse, hoist and compressor house, blower house, powder house and an incinerator. Construction work on the dikes for settling basins and filters and shaft timbering was begun in June. The dikes of the settling basins were constructed of earth with a compacted soil core. Two sand filter beds were constructed, each of about 4,000 square feet area. The settling basin and chlorinating plant was completed and a chlorinator installed ready for use on November 12.

On August 25, drilling was started at the west heading. The tunnel from this shaft was excavated by a full face heading. Mucking was done with mucking machines. The average weekly progress on tunnel excavation was 67.5 feet easterly and 72.7 feet westerly, with a maximum progress of 78.5 feet in the east section and 94.5 feet in the west section for the week ending September 29. At the end of the year the excavation under this contract at Shaft 2 was 742.5 feet easterly and 1,018.5 feet westerly, making a total of 1,761 feet. Pumpage from the tunnel at the end of the year was at the rate of about 194 gallons per minute.

The principal items of plant at Shaft 2 were as follows:

- 3 Air Compressors, each of 642 cu. ft. per min. capacity, run by 125 H. P. motors.
- 1 Small air storage tank.
- 1 14'-0" x 4'-6" air receiver tank.
- 1 Drum hoist with 100 H. P. motor.
- 1 Blower rated at 4,000 cu. ft. of free air per min., run by 60 H. P. motor.
- 1 3½-ton gasoline locomotive, friction drive, 36-inch gauge.
- 4 5-ton storage battery locomotives, 36-inch gauge.
- 1 Motor-generator set; 27 K. W. generator, 40 H. P. motor.
- 3 Mucking machines, 36-inch gauge.
- 9 Pumps, the largest of which has a rated capacity of 290 gals. per min. under 320-foot head, driven by 40 H. P. motor.
- 1 50-foot timber head-frame and equipment.
- Cars, machine shop equipment, drill equipment, etc.

*Shaft 3.* — Except to keep the tunnel pumped free of water there was no work done at this shaft during the year under Contract 14. The average pumpage at the end of the year was approximately 210 gallons per minute.

The principal items of plant at Shaft 3 were as follows: —

- 1 Single drum mine hoist with 100 H. P. electric motor.
- 1 Centrifugal pump rated at 290 gals. per min. under 365-foot head, run by 50 H. P. motor.
- 1 Two-stage 4" centrifugal pump with 60 H. P. motor.
- 1 Steel head-frame, and appurtenant hoisting equipment.

*Shaft 4.* — Work at Shaft 4 under Contract 14 was begun during the week ending June 2, 1928, with the construction of camp and plant buildings consist-

ing of 3 bunk houses, one cottage, cook's living quarters, kitchen and mess hall, contractor's office and emergency hospital, wash house, engineers' office, hoist and compressor house, blower house, blacksmith shop, battery charging house, machine shop and storehouse, oil storage house and powder house. Construction of the settling basin dikes was begun on July 16, timbering of the shaft on August 13, drilling in the east heading on October 9 and in the west heading on October 20.

The tunnel was excavated with a full face heading until about the middle of November when the top heading and bench method was employed. The weekly progress on tunnel excavation averaged 66.0 feet easterly and 59.8 feet westerly with a maximum of 86.5 feet easterly and 73 feet westerly on the week ending December 1. At the end of the year the excavation under this contract at Shaft 4 was 528.5 feet easterly and 359 feet westerly, making a total of 887.5 feet. Pumpage at the end of the year was at the rate of about 190 gallons per minute.

The principal items of plant at Shaft 4 were as follows:

- 3 Air compressors, each of 642 cu. ft. per min. capacity, run by 125 H. P. induction motors.
- 1 Small air storage tank.
- 1 14'-0" x 4'-6" air receiver tank.
- 1 Drum hoist with 100 H. P. motor.
- 1 Blower rated at 4,000 cu. ft. of free air per min., run by 60 H. P. motor.
- 5 5-ton storage battery locomotives, 36-inch gauge.
- 1 Motor-generator set; 27 K. W. generator, 40 H. P. motor.
- 3 Mucking machines, 36-inch gauge.
- 2 Centrifugal pumps, each rated at 300 gals. per min., 490-foot head, run by 75 H. P. motors.
- 1 50-foot timber head-frame and equipment.
- Cars, machine shop equipment, drilling equipment, etc.

The work done and materials furnished under the principal items of Contract 14 were as follows:

	Shaft 1	Shaft 2	Shaft 3	Shaft 4
Earth excavation for shafts (cu. yds.)	970	—	—	—
Rock excavation in shafts, and in tunnel within 50' of shafts (cu. yds.)	1,886	—	—	—
Excavation in tunnel, except within 50' of shafts (cu. yds.)	—	11,663	—	5,964
Shaft & tunnel drainage (lin. ft.)	158	1,761	—	887
Forms for preliminary concrete lining, Shaft 1 (lin. ft.)	132	—	—	—
Concrete masonry in shafts (cu. yds.)	776	—	—	—
Concrete masonry not in shafts or tunnel (cu. yds.)	1,158	27	—	17
Portland cement (bbls.)	3,160	35	—	25
Earth excavation except for shafts (cu. yds.)	7,510	2,260	—	5,616
Rock excavation except in shafts or tunnel (cu. yds.)	423	35	—	771
Refilling and embankment (cu. yds.)	4,190	6,220	—	4,193
The contractor's total force averaged (men)	31	70	3	54

CONTRACT 17. — Contract 17, for the west portion of the Wachusett-Coldbrook Tunnel in Rutland, Oakham and Barre, and including the construction of Shaft 8, 253 feet deep, at the site of the Ware River Intake Works, was executed on April 30, 1928, with Johnston P. Porter, R. Frederick Porter and Lawrence T. Porter, individually and as co-partners doing business under the firm name and style of J. P. Porter & Sons, and James J. Coughlan & Sons, Inc., who likewise assigned the contract to the West Construction Co. At the time the contract was let, Shafts 5, 6 and 7 had been sunk to tunnel grade and 4,429 feet of tunnel had been excavated under Contracts 4 and 8. Shaft timbering was started immediately.

Garbage was taken away by local farmers, sink wastes were disposed of in septic tanks, the effluent leeching into porous ground, and human excreta were incinerated, except at Shaft 7, where plumbing fixtures draining to the same cesspools as the sink drainage were used.

The top heading and bench method was finally employed in driving tunnel at all shafts. Mucking was done both by hand and by mechanical muckers and at the end of the year 6,171.5 feet of tunnel had been excavated under this contract in this division. The value of the work done on this contract to November 15, the date of the latest estimate, was \$491,603.64 of which 90 per cent was approved for payment.

Shaft 5. — During the week ending May 19, 1928, work on camp construction and timbering of the shaft was started. The camp buildings include mess hall





CONTRACT 14. — Head Frame at Shaft 4, Spoil Bank in Background.



CONTRACT 14. — Track Turn-outs in the Tunnel at the Bottom of Shaft 2.





and kitchen, 5 bunk houses, 1 cottage, dry house and emergency hospital. The buildings at the shaft include general office, engineers' office, hoist room and compressor house, 2 mule sheds, blower house, blacksmith shop and supply room. Tunnel excavation was started on September 10. The average weekly progress on tunnel excavation was 78.7 feet easterly and 81.8 feet westerly with a maximum, during the week ending December 1, 1928, of 86.5 feet easterly and 93.0 feet westerly. At the end of the year the excavation under this contract at Shaft 5 was 956.0 feet in the section east of the shaft and 1,000.0 feet in the west, a total of 1,956.0 feet. Temporary timbering was placed in the easterly section for a length of about 71 feet. At the end of the year, pumpage was at the rate of about 73 gallons per minute.

The principal items of plant at Shaft 5 were as follows:

- 3 Air compressors, with a combined capacity of 1,702 cu. ft. per min., the largest of which has a capacity of 642 cu. ft. per min. and is run by 100 H. P. motor.
- 1 Hoist, run by 150 H. P. motor.
- 1 Blower, rated at 4,000 cu. ft. of free air per min., run by 60 H. P. motor.
- 1 10'-0" x 3'-6" air receiver tank.
- 3 Mucking machines.
- 4 Pumps, the largest of which is rated at 300 gals. per min. under 670-foot head, run by 100 H. P. motor.
- 1 50-foot timber head-frame and equipment.
- Cars, machine shop equipment, drilling equipment, etc.

*Shaft 6.* — During the week ending May 19, 1928, work was started on the shaft timbering and on the enlargement of the camp already built. The camp buildings include emergency hospital, 4 bunk houses, 2 shanties, 1 cottage, general office, engineers' office and mess hall. The buildings at the shaft include mule shed, hoist room and compressor house, storage building, blower house, blacksmith shop and 2 coal sheds. Excavation was started on August 4 and the average weekly progress to the end of the year was 61.4 feet in an easterly direction and 65.2 feet westerly with a maximum for the week ending December 1, 1928, when 71.0 feet was excavated in the east section and 89.5 feet in the west. At the end of the year the excavation under this contract at Shaft 6 was 1,060.0 feet in the section east of the shaft and 1,117.0 feet in the section west, a total of 2,177.0 feet. Pumpage at the end of the year was approximately 27 gallons per minute.

The principal items of plant at Shaft 6 were as follows:

- 3 Air compressors, with a combined capacity of 1,623 cu. ft. per min., the largest of which has a capacity of 751 cu. ft. per min. and is run by 150 H. P. motor.
- 1 Blower, rated at 4,000 cu. ft. of free air per min., run by 60 H. P. motor.
- 1 Hoist with 100 H. P. motor.
- 1 10'-0" x 3'-6" air receiver tank.
- 2 Mucking machines.
- 6 Pumps, the largest of which has a rated capacity of 200 gals. per min. under 460-foot head, run by 25 H. P. motor.
- 1 50-foot timber head-frame and equipment.
- Cars, machine shop equipment, drilling equipment, etc.

*Shaft 7.* — Work was begun at Shaft 7 during the week ending May 19 with camp construction and shaft timbering. The camp buildings include a mess hall and kitchen, 4 bunk houses, wash house, 3 cottages and emergency hospital. Buildings at the shaft include general office, engineers' office, mule shed, hoist room and compressor house, storage building, blower house, blacksmith shop and locker house.

On August 11, tunnel excavation was started. The average weekly progress at this shaft was 55.7 feet easterly and 70.1 feet westerly, with a maximum of 56.5 feet easterly and 85.5 feet westerly in the week ending October 20. At the end of the year the excavation under this contract at Shaft 7 was 908.0 feet in the section east of the shaft and 1,130.5 feet west, a total of 2,038.5 feet. To support blocky, disintegrated rock in a short section west of the shaft permanent timbering was placed for a distance of 22 feet. Pumpage at the end of the year was about 325 gallons per minute.

The principal items of plant at Shaft 7 were as follows:

- 3 Air compressors, with a combined capacity of 1,551 cu. ft. per min., the largest of which has a capacity of 751 cu. ft. per min. and is run by a 150 H. P. motor.
- 1 Hoist, driven by 100 H. P. motor.

- 1 10'-0" x 3'-6" air receiver tank.
- 1 Blower, rated at 4,000 cu. ft. of free air per min., run by 60 H. P. motor.
- 2 Mucking machines.
- 7 Pumps, the largest of which has a rated capacity of 450 gals. per min. under 160-foot head, driven by 30 H. P. motor.
- 1 50-foot head-frame and equipment.
- Cars, machine shop equipment, drilling equipment, etc.

*Shaft 8.* (Under the supervision of the Hardwick Office of the Coldbrook-Swift Tunnel Division). — Construction at Shaft 8 was begun on May 5, 1928. The contractor erected near the shaft site a general office and emergency hospital, several bunk houses, a mess house, and buildings for housing equipment. An engineers' office was established near the shaft in a building owned by the Commission. The top of the shaft was closed in on three sides by concrete foundation walls of the future intake structure and a wooden bulkhead, sealed at the bottom by rammed and puddled earth, made the fourth side. The shaft was excavated, the preliminary lining placed, the east tunnel driven 142.5 feet and the west tunnel 135.0 feet when on November 10 the work was discontinued in order to install the cages in the shaft. Pumpage at the shaft did not exceed 10 gallons per minute until a stream of about 90 gallons per minute was encountered about 90 feet below the surface. This stream was confined to a pipe and shut off, after which the shaft pumpage decreased to 20 gallons per minute and finally 10 gallons per minute at the completion of the shaft. Pumpage again increased to about 50 gallons per minute with the start of tunnel excavation. From a spring encountered in the shaft the water supply is pumped to an elevated tank, from which the various buildings are supplied by gravity.

#### MISCELLANEOUS CONSTRUCTION DATA, SHAFT 8

Total depth of shaft	253 feet
Depth of earth	3 feet
Work begun	May 5, 1928
Earth excavation begun	May 23, 1928
Rock excavation begun	June 1, 1928
Maximum depth of rock excavated in one week	25 feet
First concrete lining placed	July 8, 1928
Shaft excavation completed	Oct. 10, 1928
Tunnel excavation started	Oct. 5, 1928

The principal items of plant used in sinking Shaft 8 or delivered ready for installation as a part of the tunnel excavating plant are summarized as follows:

#### EQUIPMENT ON HAND, IN USE

- 2 Air compressors, each of 750 cu. ft. per min. capacity, run by 100 H. P. motors.
- 1 Steam hoist.
- 1 Stiff leg derrick.
- 3 Pumps, the largest of which has a rated capacity of 190 gal. per min., under 240-foot head.
- Cars, drill equipment, machine shop equipment, etc.

#### EQUIPMENT ON HAND, NOT IN USE

- 1 Air compressor, capacity 750 cu. ft. per min.
- 1 Mine hoist.
- 1 Pump, capacity 300 gal. per min. under 275-foot head, run by 40 H. P. motor.
- 1 Concrete mixer, gasoline,  $\frac{3}{4}$  cu. yd. capacity.
- 3 Mucking machines.

The work done and materials furnished under the principal items of Contract 17 were as follows:

	Shaft 5	Shaft 6	Shaft 7	Shaft 8
Rock excavation in shafts, and in tunnel within 50' of shafts (cu. yds.)	—	—	—	4,664
Excavation in tunnel, except within 50' of shafts (cu. yds.)	13,261	14,599	13,385	1,211
Shaft and tunnel drainage (lin. ft.)	1,953	2,178	2,038	522
Forms for preliminary concrete lining, Shaft 8 (lin. ft.)	—	—	—	217
Concrete masonry in shafts (cu. yds.)	9	—	—	715
Concrete masonry not in shafts or tunnel (cu. yds.)	—	—	—	300
Permanent timbering in tunnel (M ft. BM)	—	—	1.84	—
Temporary timbering in tunnel (M ft. BM)	3.44	—	—	—
Portland cement (bbls.)	12	—	—	1,283
Earth excavation (cu. yds.)	—	—	—	570
Rock excavation except in shafts or tunnel (cu. yds.)	—	—	—	760
The contractor's total force averaged (men)	73	76	72	50



## COLDBROOK-SWIFT TUNNEL DIVISION — HARDWICK OFFICE

The Coldbrook-Swift Tunnel Division has charge of the field work in connection with the proposed Coldbrook-Swift Tunnel extension to the Swift River Reservoir and of the construction at the Ware River Intake at Shaft 8 of the Wachusett-Coldbrook Tunnel included in Contract 17 and hereinbefore described. The division office was continued at Hardwick Center and a field office was established at Shaft 8 after work under Contract 17 was begun. Stream flow measurements and studies were made by the personnel of this office under the immediate supervision of engineers from the Headquarters office.

*Office Work*

Topographic plans were prepared for the diversion dam on the Ware River at Shaft 8 and for Shafts 9, 10, 11 and the west portal of the Coldbrook-Swift Tunnel. Real estate maps covering proposed takings for the tunnel, and of various properties in the Ware River valley upsteam from Shaft 8 were made. Cross sections of Shaft 8 were plotted and estimates prepared. Compressive tests were made on concrete test cylinders cast at the intake works at Shaft 8. These tests were made at the Worcester Polytechnic Institute.

*Field Work*

A precise taping of the Coldbrook-Swift Tunnel center line was made and later checked by triangulation. Precise level runs were made to supplement those made last year. Surveys were made of the real estate along the Coldbrook-Swift Tunnel line, of various water power privileges and properties upstream from the Ware River Intake, of the Village of White Valley and of the dam of the White Bros. mill pond. Rod soundings and topography were taken at the site of the Portal of the Coldbrook-Swift Tunnel, a profile for a short distance along the Ware River was taken, a proposed access road to Shaft 10 was laid out and cross sectioned, and the line of the Wachusett-Coldbrook Tunnel checked. Monuments were cast and set along the Coldbrook-Swift Tunnel line and staff gages were made and set on the ponds of the Chicopee River watershed. Stream flow measurements were made on the Ware, Swift, Quaboag, Chicopee and Connecticut rivers.

*Progress of Construction*

To date all construction work supervised from the Hardwick office has been on Shaft 8 of Contract 17, hereinbefore described, with the exception of installation of small gage houses at White Valley and Bircham Bend gaging stations.

## SWIFT RIVER RESERVOIR DIVISION — ENFIELD OFFICE

The Swift River Reservoir Division has charge of the field work in the Swift River Valley in connection with the proposed Swift River Reservoir.

*Office Work*

During the year about 9,740 acres of topography within and adjacent to the proposed reservoir were mapped on a scale of  $1''=200'$ , this bringing the total mapped to 16,040 acres, 9,005 of which were traced on record tracings. Property as represented by 470 requests from owners of real estate for appraisal by the Commission was located and sketches showing approximate location of the same were returned to the Headquarters office. Property purchased by the Commonwealth was plotted on a general property map with a scale of  $1''=1,000'$ .

Real estate surveys plotted during the year amounted to 30,200 acres, making the total to date 32,997 acres. These plots were made upon mounted record topographic maps at a scale of  $1''=200'$ . Preliminary tracings covering 22,070 acres were made, and 4,700 acres were checked as final tracings. The final tracings show the ownership of the land together with metes, bounds and area, the latter of which has been subdivided into various classifications of culture.

Work on real estate titles was done as required, data pertaining to cemeteries in the reservoir area prepared and photographs taken were developed, printed and mounted as required.

*Field Work*

The field work consisted principally of surveys, topographic and real estate. During the year 5,393 acres of topography were taken, making the total to date 16,860 acres or 26.34 square miles, this being about two-thirds of the area required to be surveyed. Some detailed topography was taken in the vicinity of proposed structures. Photographs were taken of buildings acquired or recommended to be purchased both in the Swift River Valley and elsewhere. Photographs were also taken from time to time of the construction work in progress in other divisions. Real estate surveys during the year totalled 31,657 acres, making the total to date 35,915 acres or 56.12 square miles. Staff gages were set along the Swift River and read weekly.

To meet the forest fire hazard, a truck was purchased in March and equipped to carry a portable gasoline-driven fire pump, 2,500 feet of hose and other fire fighting apparatus. This equipment is housed in Enfield. Six of the assistant engineers of the division office were appointed deputy forest wardens in all of the towns in the Swift River Valley affected by the Commission's operations. The apparatus was called to 6 forest fires which threatened to spread over extensive areas. The damage was confined to a total of 47 acres of land. The apparatus also assisted at 6 building fires.

In preparation for the future removal of bodies, careful copies were made of inscriptions from all headstones and monuments in Pelham Hollow Cemetery, Prescott; Town House Cemetery, Prescott; Church Cemetery, Enfield; and Cemetery Hill Cemetery, Enfield. Locations of each headstone, monument and grave were made and 451 individual cemetery lots were photographed. In order to facilitate the work of removing bodies from the cemeteries, two employees of this division were licensed as undertakers by the towns of Enfield, Greenwich, Prescott and Dana. During the year, 40 bodies were moved to privately-owned lots outside of the reservoir area.

*SOUTHERN SUDBURY EMERGENCY SUPPLY — FRAMINGHAM OFFICE*

The construction and incidental work on the Southern Sudbury Emergency Supply was handled from the Framingham office until February 29, 1928, when, the work being nearly completed, the office was discontinued and all records, plans, field notes and supplies were turned over to the Headquarters office.

*Office Work*

Record plans and cross sections of borrow pits and special excavations on Contracts 5, 6, 7, 11, 13 and 16 were plotted and checked at the Framingham office. Property calculations and location of property bounds were made. Computations for all final estimates were completed.

*Field Work*

Besides providing lines and grades for work under construction, a survey was made on each pipe line to secure data for record plans. All angle points, gate, blow-off and relief valves, manholes, etc., were referenced to existing landmarks. Important property lines were run out and referenced and during May and June, 1928, 160 stone bounds were set.

*Progress of Contracts*

*Contract 5.* — Contract 5 with the Lock Joint Pipe Co. of Ampere, New Jersey, for the Cordaville pipe line, a 30" pipe from Cordaville to Sudbury Reservoir, was practically completed on December 17, 1927. The work was completed on April 6, 1928, the total value thereof being \$83,762.86.

The work done and materials furnished under the principal items of the contract were as follows:

	During Year ending Nov. 30, 1928	Total
Furnishing and laying 30-in. concrete pipe . . . . .	—	8,777 ft.
Furnishing and laying 18-in. cast iron pipe . . . . .	—	223 ft.
Furnishing and laying 12-in. cast iron pipe . . . . .	—	271 ft.
Earth excavation, fill and refill . . . . .	1,012 cu. yds.	9,992 cu. yds.
Rock excavation and refill . . . . .	—	367 cu. yds.



*Contract 6.* — Contract 6 with F. A. Mazzur Co., Inc., of Boston for the construction and equipment of the Cordaville pumping station was nearly finished at the beginning of the year. On December 13, 1927, the temperature in the house, maintained at 55° F., proved too low and chlorine ice formed in the chlorinating apparatus, crippling the operation and allowing chlorine gas to fill the building. A new thermostat with a range high enough to prevent hydration of the chlorine was installed. A satisfactory acceptance test on the main pump was made on October 18, 1928. The work was completed on May 16, 1928, the total value thereof being \$17,385.04.

*Contract 7.* — Contract 7 with Cenedella & Co. of Milford, Mass., for the construction of a 30-inch cast iron pipe line from Hopkinton Reservoir to a connection with the Cordaville pipe line at Cordaville, was nearly completed at the beginning of the year. The work was completed on December 27, 1927, the total value thereof being \$134,365.72.

The work done and materials furnished under the principal items of the contract were as follows:

	During Year ending Nov. 30, 1928	Total
Furnishing and laying 30-inch cast iron pipe . . . . .	—	6,977 ft.
Excavating, fill and refill . . . . .	659 cu. yds.	12,932 cu. yds.
Furnishing and placing paving . . . . .	—	80 cu. yds.
Furnishing and placing riprap . . . . .	—	267 cu. yds.
Furnishing and placing concrete . . . . .	—	43 cu. yds.
Furnishing and placing 18-inch cast iron culvert pipe . . . . .	—	120 ft.

*Contract 11.* — Contract 11 with Antonio Mogavero of Peabody, Mass., was for the construction of a 24-inch cast iron pipe line from Ashland Reservoir to the gate house at Framingham Reservoir No. 2. About 1,000 feet of the grading was left to be cleaned up in the spring of 1928. A cork and pitch frost-proofing was applied to the air relief access wells and underground Venturi meter recorder chamber. The work was practically completed early in the year, and was completed on September 24, 1928, the total value thereof being \$130,145.35.

The work done and materials furnished under the principal items of the contract were as follows:

	During Year ending Nov. 30, 1928	Total
Furnishing and laying 24-inch cast iron pipe . . . . .	—	13,426 ft.
Furnishing and laying 20-inch cast iron pipe . . . . .	—	937 ft.
Earth excavation, fill and refill . . . . .	2,102 cu. yds.	13,102 cu. yds.
Rock excavation and refill . . . . .	—	616 cu. yds.
Furnishing and placing riprap . . . . .	—	38 cu. yds.
Furnishing and placing paving . . . . .	40 cu. yds.	40 cu. yds.
Furnishing and placing concrete . . . . .	15 cu. yds.	85 cu. yds.

*Contract 13.* — Contract 13 with the Portland Contracting Company of Portland, Maine, for the construction of a 20-inch cast iron pipe line from Whitehall Reservoir to and including the diversion dam on City Brook near City Road in the Town of Hopkinton, which was nearly completed at the beginning of the year, was completed on June 12, 1928, the total value thereof being \$60,603.17.

The work done and materials furnished under the principal items of the contract were as follows:

	During Year ending Nov. 30, 1928	Total
Furnishing and laying 20-inch cast iron pipe . . . . .	400 ft.	6,750 ft.
Excavation, fill and refill . . . . .	2,102 cu. yds.	6,702 cu. yds.
Excavation at diversion dam . . . . .	—	464 cu. yds.
Furnishing and placing impervious core and blanket at diversion dam . . . . .	9 cu. yds.	739 cu. yds.
Furnishing and placing pervious embankment . . . . .	—	1,589 cu. yds.
Furnishing and placing soil dressing . . . . .	—	158 cu. yds.
Furnishing and placing concrete . . . . .	14 cu. yds.	64 cu. yds.
Furnishing and placing paving . . . . .	41 cu. yds.	66 cu. yds.

*Contract 15.* — Since June 1 the Metropolitan District Commission has assumed the payments to the Marlborough Electric Company under Contract 15 for fur-

nishing electricity at the Cordaville pumping station on the line from Hopkinton Reservoir to Sudbury Reservoir. Monthly payments up to that time totalled \$270.09.

*Contract 16.* — Contract 16 with the Sanders Engineering Company of Portland, Maine, for an open channel from the reservoir formed by the dam built under Contract 13 to the Hopkinton Reservoir, was nearly completed at the beginning of the year. The work was completed on July 9, 1928, the total value thereof being \$32,695.16.

The work done and materials furnished under the principal items of the contract were as follows:

	During Year ending Nov. 30, 1928	Total
Clearing . . . . .	1.4 acres	26.6 acres
Grubbing . . . . .	0.3 acre	7.3 acres
Excavation . . . . .	4,352 cu. yds.	17,852 cu. yds.
Gravel fill . . . . .	254 cu. yds.	254 cu. yds.
Furnishing and placing concrete . . . . .	1 cu. yd.	32 cu. yds.

### GEOLOGICAL DATA

Chapter 321, Acts of 1927, provides that the Commission shall collect and publish in its reports such information as to the geology of the region in which any of the works which it is authorized to construct may be located as may be of value in connection with the geological history of the state. Such information was published in the annual report for the year ending November 30, 1927, since which time tunnel excavation from six shafts located in the towns of Holden and Rutland on the Wachusett-Coldbrook Tunnel has been prosecuted to an aggregate length of about 18,000 feet. Shaft 1 at the east end of this tunnel in the Town of West Boylston has been sunk to a depth of 159 feet, 129 feet of which is in rock, and Shaft 8 at the Ware River intake in the Town of Barre has been completed, the total depth being about 253 feet, practically all of which is in rock. No further geologic data is as yet available in the valley of the Swift River or at the Beaver Brook dike of the Swift River Reservoir. Borings were completed on the tunnel extension from Shaft 8 to the Swift River Reservoir in December, 1927.

Surface and rock profiles developed from these borings along the Wachusett-Coldbrook and the proposed Coldbrook-Swift tunnels reveal the following data as to probable cover above the tunnel, not including that portion in the vicinity of the portal:

*Maximum Overall Cover.* — Approximately 820 feet, all rock, located between Shafts 4 and 5 in the Town of Rutland.

*Minimum Overall Cover.* — Approximately 115 feet (includes 67 feet± of rock and 48 feet± of unconsolidated drift); located between Shaft 11 in Muddy Brook Valley in the Town of Hardwick, and the portal in the Town of Greenwich.

*Lowest Rock.* — Elevation 373; located at Shaft 1 in the Town of West Boylston.

*Highest Rock.* — Elevation 1,220 feet±; located between Shafts 4 and 5 in the Town of Rutland.

Deepest drift cover penetrated by diamond drill borings — 135 feet located between Shaft 11 and the portal.

### STRUCTURE AND DISTRIBUTION OF THE FORMATIONS

Of the rocks exposed in borings and excavations to date, there is a great variety in quality and appearance because of original differences in composition. A further variety is occasioned by the fact that some of these works are mixed with a granite, making thereby products quite unlike either one of the originals. All of the non-igneous rocks are metamorphosed, some of them extremely so, and in the areas of the highly injected schists and gneisses, it is somewhat difficult to determine whether the rock was originally sedimentary or igneous.

From information obtained to date, the Wachusett-Coldbrook Tunnel is being or may be expected to be excavated through the following rock formations:

1. A fine grained but distinctly granular phyllitic quartzite which is plainly foliated, occurring rather extensively in the east portion of the tunnel. This rock grades from a quartz-mica phyllite to a quartzite by the increase of quartz and



decrease of mica, and in addition to the high percentage of quartz, there are also present considerable quantities of carbonate, which seem to permeate the quartzose groundmass. This rock, as it occurs in Shaft 1, is divided by numerous cross-fractures, some of which are completely sealed with calcite veining.

2. A light colored biotite-muscovite granite, grading between an almost pure feldspar-quartz rock without mica and one with large amounts of black and brown mica. Extensive pegmatitic facies are also present. This rock has previously, in the preliminary geological map of Massachusetts, been given the name of Fitchburg Granite, and has been mapped as occurring along the east half of the tunnel. There is also, however, a granite occurring in the western part of the tunnel area, and this has also been classified tentatively as belonging to the Fitchburg Granite, as studies made to date do not warrant a new name. There is not much difference in character or quality, and the behavior in other respects, such as its mixing and injection relations to the overlying schists is about the same.

The granite, as found in the eastern section of the tunnel area, is composed chiefly of quartz, abundant microcline and orthoclase, albite and other accessory minerals such as magnetite, apatite, and titanite. It is essentially fresh and shows only slight alteration. Where it has come into proximity to the schists, there is a considerable increase in mica. The granites so far studied as found in the western section of the tunnel area, show only small changes in the mineral content, there being practically no change in the essential primary minerals, but a few additional secondary minerals including leucoxene and epidote. In some cases they take on a marked foliated or gneissic structure.

3. A medium grained quartz-mica schist, which appears to be the most extensively developed single type. In some places it is very quartzose becoming essentially a quartzite or quartzitic schist. It is commonly very micaceous and schistose. In its simplest and finest grain, it somewhat resembles the phyllitic quartzite mentioned above. Some variations in its character are shown by the addition of feldspars, with considerable amounts of calcite and zircon, the latter being prominent by the halos surrounding most of the grains. This rock has previously, in the preliminary geological map of Massachusetts, been given the name of Paxton Quartz Schist.

4. A strongly and finely foliated mica schist showing generally a very strong structure. Some occurrences are wholly micaceous, and indicate metamorphism from a carbonaceous shale. The whole is considerably injected with granite and pegmatite, which produces some variations in the rock, especially in increasing the garnet content and introducing feldspathic substances, thus making it a little abnormal from the type.

5. The first three types seldom occur in a simple condition but are generally mixed, making the rock in part quartzitic or phyllitic, as the case may be, and in part granite. Portions of it are coarse grained pegmatite, which gives to the rock a gneissic effect, and other portions are quartz-mica or mica-schist. The resultant mixed rock is so prominent and widespread that it has been given a tentative formational name of Paxton Mixed Injection Schist. It therefor includes a great variety, varying from simple schists on one side with small amounts of injected igneous material to gneissoid granites on the other with included, partly digested, and redistributed material from the original overlying schists. In the vicinity of Shaft 8, these rocks are predominantly of igneous origin, with foliated structure; and in some cases show an augen structure with feldspar phenocrysts.

Due to the great lengths of tunnel to be excavated between the headings at the shafts, and also to the scarcity of surface outcrops along the line, it is impossible at this time to set any exact limits to these formations. Beginning at the east end and going westward there is probably the following sequence of formations. The phyllitic quartzite extends from east of Shaft 1 to approximately 3,000 feet west, where it appears to dip at a small angle ( $25^{\circ}$ ) into the Fitchburg Granite. The Fitchburg Granite comes next and apparently continues for most of the distance to Shaft 3. The general structure can be observed in the included highly quartzose and feldspathic schist rocks, and is seen to be very flat, there being only slight variations in the dip from the horizontal. The structure, as plotted from measurements taken close together, shows a slight wavy or rolling schistosity, but when all

the small variations are averaged, the resultant structure is near the horizontal. Throughout the excavation, at this time, the percentage of included schist is considerable. The intrusive relation of the granite to the schist is clear. The next section of tunnel to somewhere between Shafts 3 and 4 is chiefly mica schist with numerous granite and pegmatitic bodies. The short section of tunnel excavated at Shaft 3 shows the poorest quality of rock of any of the formations. It has been extremely crushed and folded and has a dominant fracture cleavage, but some specimens taken from between these surfaces show minute crenulated folds. The schist, in this short section of tunnel, is considerably intruded with the Fitchburg Granite and pegmatite, and because of the end-stage and subsequent alteration to the latter a rather soft and considerably disintegrated rock has resulted, requiring four short lengths of timbering to be placed. The granite intrusives are confined to large cross cutting veins, some of dike proportions, whereas the pegmatite seems to have permeated the schist and its effects can be seen at remote distances from the main body. The distance between Shafts 4 and 6 is taken up by almost straight Paxton Quartz Schist, with some variations to the more quartzitic type together with some lenses of more shaley rock. The structure between these points, as interpolated from tunnel excavations, and a few surface outcrops, is horizontal or nearly so. A very striking example is found at Shaft 5, in the middle of this belt, where for a depth of 650 feet in the shaft and approximately 3,300 feet in the tunnel, the dip does not vary more than 10 to 15 degrees from the horizontal. The rock, throughout this section, is distinctly bedded, and is intruded by pegmatite, chiefly consisting of orthoclase. These intrusions are found in the form of large isolated augens with stringer veins, and appear to cut across the bedding, indicating a fusion and replacement of the schist, rather than dynamic injection. Very close to Shaft 6 the Paxton Quartz Schist merges into a mixed schist and granite rock, called here the Paxton Mixed Injection Schist. The contact is not clearly defined, but seems to extend over an area as the former loses its identity as such gradually with increases of the mixed schist rock. Minor faulting in the quartz schist indicates a fault contact, now obscured by granitic injections. The Paxton Mixed Injection Schist extends from Shaft 6 to Shaft 8, with intervening bodies, uncertain in extent, of granite of the Fitchburg type. At Shaft 7 the intrusive relation of the granite to the schist is very clear, as in a great many sections it results in a marked banded or ribbon gneiss effect, which has resulted from the granite replacing the schist only in part. The prevailing dip at this point is about 30° east, and at Shaft 8 it is about 40° west. The ribbon gneiss effect is not so apparent at this latter point.

The tunnel excavations to date, taken as a whole, are comparatively dry, and no one formation can be pointed out as being a large water bearer. The Paxton Quartz Schist is the driest formation, whereas the Fitchburg Granite and Paxton Mixed Injection Schist, are letting water into the tunnel at greater rates. The water, at these points of leakage, is coming in mainly along joints, and crush zones. The mica schist at Shaft 3, due to its broken and disintegrated condition, allows water to enter from a great many small fractures, rather than from any particular set of joints.

#### LIST OF DRAWINGS AND TABLES

For General Plan of Metropolitan Water Supply and Profile of Wachusett-Coldbrook Tunnel, see Second Annual Report.

The following tabulations are appended to this report:

Monthly Progress — Real Estate Negotiations for the Swift River Reservoir.  
 Location of Real Estate Acquired for the Swift River Reservoir.  
 Real Estate Takings.  
 Status of Contracts in Force between Nov. 30, 1927, and Nov. 30, 1928.  
 Total Value of Work Accomplished under Contracts in Progress During Year Ending November 30, 1928.  
 Canvass of Bids, Contracts 14 and 17.

Respectfully submitted,

FRANK E. WINSOR,  
*Chief Engineer.*



# FINANCIAL STATEMENT OF THE METROPOLITAN DISTRICT WATER SUPPLY COMMISSION

EXPENDITURES AND DISBURSEMENTS FOR THE FISCAL YEAR AND FROM JULY 28,  
1926, THE DATE OF THE APPOINTMENT OF THE COMMISSION

## GENERAL OVERHEAD

	Year ending Nov. 30, 1928	Total to Nov. 30, 1928
<b>ADMINISTRATION (Commissioners' Office):</b>		
Salaries, Commissioners . . . . .	\$10,500.00	\$24,612.80
Salaries, Clerical . . . . .	10,210.00	17,729.03
General Legal Expense . . . . .	962.82	1,377.30
Furniture and Fixtures . . . . .	-422.37	1,814.78
Rent and Upkeep . . . . .	2,961.71 <sup>1</sup>	2,961.71
Automobile Purchase . . . . .	809.00 <sup>4</sup>	809.00
Automobile Maintenance . . . . .	418.71	668.48
Miscellaneous Expense (undistributed) . . . . .	601.22	4,732.80
Advertising . . . . .	748.65	748.65 <sup>2</sup>
Printing and Blueprinting . . . . .	1,121.85	1,121.85 <sup>2</sup>
Stationery and Office Supplies . . . . .	289.95	289.95 <sup>2</sup>
Postage . . . . .	133.69	133.69 <sup>2</sup>
<b>Total Administration . . . . .</b>	<b>\$28,335.23</b>	<b>\$57,000.04</b>
<b>ENGINEERING, HEADQUARTERS OFFICE:</b>		
Salaries, Engineering . . . . .	\$78,630.29	\$146,435.10
Salaries, Clerical . . . . .	8,717.90	17,315.80
General Consultant Expense . . . . .	17,417.08	26,497.52
Furniture and Fixtures . . . . .	1,999.73	10,407.82
Laboratory Equipment . . . . .	1,425.48	1,425.48
Laboratory Supplies . . . . .	1,369.50	1,369.50
Rental of Equipment . . . . .	865.00	865.00
Engineering Instruments . . . . .	40.62	40.62
Rent and Upkeep of Boston Office . . . . .	9,739.47	21,579.62
Rent and Upkeep of Springfield Laboratory . . . . .	576.88	576.88
Automobile Purchase . . . . .	1,495.70 <sup>4</sup>	1,495.70
Automobile Maintenance . . . . .	550.00	807.30
Special Experiments . . . . .	2,304.63	2,304.63
Miscellaneous Expense (undistributed) . . . . .	3,279.07	8,289.28
Printing and Blueprinting . . . . .	2,387.71	2,387.71 <sup>2</sup>
Stationery and Office Supplies . . . . .	907.29	907.29 <sup>2</sup>
Postage . . . . .	205.07	205.07 <sup>2</sup>
<b>Total Engineering, Headquarters Office . . . . .</b>	<b>\$131,911.42</b>	<b>\$242,910.32</b>
<b>UNASSIGNED:</b>		
Unassigned Supplies and Equipment . . . . .	-\$505.17	\$1,068.81
<b>Total Unassigned . . . . .</b>	<b>-\$505.17</b>	<b>\$1,068.81</b>
<b>Total General Overhead . . . . .</b>	<b>\$159,741.48</b>	<b>\$300,979.17</b>

DISTRIBUTION OF GENERAL OVERHEAD

	Year ending Nov. 30, 1928	Total to Nov. 30, 1928
ADMINISTRATION:		
Wachusett-Coldbrook Tunnel Division . . . . .	\$9,784.48	\$20,760.21
Coldbrook-Swift Tunnel Division . . . . .	2,020.15	3,369.52
Swift River Reservoir Division . . . . .	15,207.76	24,225.18
Southern Sudbury Emergency Supply . . . . .	1,322.84	8,645.13
Total Administration . . . . .	\$28,335.23	\$57,000.04
ENGINEERING, HEADQUARTERS OFFICE:		
Wachusett-Coldbrook Tunnel Division . . . . .	\$42,565.56	\$85,945.86
Coldbrook-Swift Tunnel Division . . . . .	7,693.27	12,336.56
Swift River Reservoir Division . . . . .	76,812.49	111,630.48
Southern Sudbury Emergency Supply . . . . .	4,840.10	32,997.42
Total Engineering, Headquarters Office . . . . .	\$131,911.42	\$242,910.32
WACHUSETT-COLDBROOK TUNNEL DIVISION		
	Year ending Nov. 30, 1928	Total to Nov. 30, 1928
GENERAL OVERHEAD:		
Administration . . . . .	\$9,784.48	\$20,760.21
Engineering . . . . .	42,565.56	85,945.86
Total General Overhead . . . . .	\$52,350.04	\$106,706.07
ENGINEERING:		
Salaries, Engineering and Clerical . . . . .	\$65,785.81	\$112,858.75
Consultant Expense . . . . .	1,082.41	1,628.06
Furniture and Fixtures . . . . .	—8,614.01	1,070.63
Engineering Instruments . . . . .	7,141.00 <sup>3</sup>	7,141.00
Rent and Upkeep . . . . .	1,993.08	3,927.64
Automobile Purchase . . . . .	4,514.96 <sup>4</sup>	4,514.96
Automobile Maintenance . . . . .	2,851.51	5,105.99
Contracts for Investigations and Surveys . . . . .	16,075.11 <sup>5</sup>	16,075.11
Miscellaneous Expense (undistributed) . . . . .	—16,069.14	2,987.52
Advertising . . . . .	4.22 <sup>1</sup>	4.22
Printing and Blueprinting . . . . .	392.01 <sup>1</sup>	392.01
Stationery and Office Supplies . . . . .	1,338.90 <sup>1</sup>	1,338.90
Postage . . . . .	175.35 <sup>1</sup>	175.35
Total Engineering . . . . .	\$76,671.21	\$157,220.14
REAL ESTATE (General Construction):		
Legal and Expert Expense . . . . .	\$1,468.41	\$3,512.46
Consultant Expense . . . . .	394.40	394.40
Labor . . . . .	1,016.55	1,016.55
Miscellaneous Expense . . . . .	16.24	241.24
Purchases and Settlements . . . . .	79,822.46	96,382.46
Taxes . . . . .	652.78	757.12
Police Protection, Labor . . . . .	10.00	10.00
Special Agents, Salaries . . . . .	1,083.00	1,083.00
Furniture and Fixtures . . . . .	117.67	117.67
Automobile Purchase . . . . .	595.50	595.50
Automobile Maintenance . . . . .	121.69	121.69
Miscellaneous Expense (undistributed) . . . . .	76.35	76.35
Printing . . . . .	7.89	7.89
Total Real Estate . . . . .	\$85,382.94	\$104,316.33



	Year ending Nov. 30, 1928	Total to Nov. 30, 1928
<b>WARE WATERSHED PROTECTION:</b>		
Legal and Expert Expense . . . . .	\$2,276.10	\$2,724.43
Consultant Expense . . . . .	197.30	763.70
Labor . . . . .	795.00	1,265.00
Miscellaneous Expense . . . . .	23.63	45.84
Purchases and Settlements . . . . .	71,205.48	294,488.66
Taxes . . . . .	0.00	4,960.92 <sup>6</sup>
Total Ware Watershed Protection . . . . .	\$74,497.51	\$304,248.55
<b>WARE SUPPLY DAMAGES:</b>		
Consultant Expense . . . . .	—\$591.70	\$0.00
Total Ware Supply Damages . . . . .	—\$591.70	\$0.00
<b>WARE DIVERSION DAMAGES:</b>		
Consultant Expense . . . . .	\$0.00	\$452.39
Contracts for Investigations and Surveys . . . . .	63.27	63.27
Miscellaneous Expense (undistributed) . . . . .	330.03	1,595.03
Printing and Blueprinting . . . . .	24.99	24.99
Total Ware Diversion Damages . . . . .	\$418.29	\$2,135.68
<b>PERMANENT CONSTRUCTION — CONSTRUCTION CONTRACTS:</b>		
Contract No. 4, Sinking Shaft 5 and driving 1,367 linear feet of tunnel . . . . .	\$198,158.83	\$290,581.99
Contract No. 8, Sinking Shafts 6 and 7 and driving 3,062.2 linear feet of tunnel . . . . .	335,617.53	456,784.26
Contract No. 10, Construction and maintenance of Transmission Line . . . . .	7,158.50	95,765.09
Contract No. 12, Sinking Shafts 2, 3 and 4 and driving 3,809.6 linear feet of tunnel . . . . .	451,564.28	632,727.44
Contract No. 14, Construction of East Portion of Wachusett-Coldbrook Tunnel and Shaft 1 . . . . .	241,650.13	241,650.13
Contract No. 17, Construction of West Portion of Wachusett-Coldbrook Tunnel and Shaft 8 . . . . .	442,443.28	442,443.28
Total Contracts . . . . .	\$1,676,592.55	\$2,159,952.19
<b>PERMANENT CONSTRUCTION — EXCEPT CONSTRUCTION CONTRACTS:</b>		
Installed Equipment . . . . .	\$91.88 <sup>1</sup>	\$91.88
Temporary Equipment . . . . .	4,750.10	4,750.10
Miscellaneous Expense . . . . .	446.58	888.02
Investigations and Surveys . . . . .	898.34	898.34
Total . . . . .	\$6,186.90	\$6,628.34
Total Wachusett-Coldbrook Tunnel Division . . . . .	\$1,971,507.74	\$2,841,207.30
<b>COLDBROOK-SWIFT TUNNEL DIVISION</b>		
<b>GENERAL OVERHEAD:</b>		
Administration . . . . .	\$2,020.15	\$3,369.52
Engineering . . . . .	7,693.27	12,336.56
Total General Overhead . . . . .	\$9,713.42	\$15,706.08

	Year ending Nov. 30, 1928	Total to Nov. 30, 1928
<b>ENGINEERING:</b>		
Salaries, Engineering and Clerical . . . . .	\$20,636.19	\$28,297.69
Furniture and Fixtures . . . . .	-3,570.88	225.49
Engineering Instruments . . . . .	3,284.77 <sup>3</sup>	3,284.77
Rent and Upkeep . . . . .	1,649.46	1,738.86
Automobile Purchase . . . . .	1,980.00 <sup>4</sup>	1,980.00
Automobile Maintenance . . . . .	1,752.00	2,363.15
Contracts for Investigations and Surveys . . . . .	12,831.65 <sup>5</sup>	12,831.65
Materials of Construction . . . . .	2.25	2.25
Miscellaneous Expense (undistributed) . . . . .	-6,883.35	1,847.73
Printing and Blueprinting . . . . .	113.09 <sup>1</sup>	113.09
Stationery and Office Supplies . . . . .	595.66 <sup>1</sup>	595.66
Postage . . . . .	93.93 <sup>1</sup>	93.93
Total Engineering . . . . .	\$32,484.77	\$53,374.27
<b>REAL ESTATE:</b>		
Legal and Expert Expense . . . . .	\$220.98	\$413.82
Miscellaneous Expense . . . . .	4.80	12.30
Purchases and Settlements . . . . .	236.30	236.30
Taxes . . . . .	867.47	867.47
Fire Protection, Equipment . . . . .	17.06	17.06
Total Real Estate . . . . .	\$1,346.61	\$1,546.95
<b>PERMANENT CONSTRUCTION — EXCEPT CONSTRUCTION CONTRACTS:</b>		
Installed Equipment . . . . .	\$91.87 <sup>1</sup>	\$91.87
Miscellaneous Expense . . . . .	-91.87	0.00
Total . . . . .	\$0.00	\$91.87
Total Coldbrook-Swift Tunnel Division . . . . .	\$43,544.80	\$70,719.17
<b>SWIFT RIVER RESERVOIR DIVISION</b>		
	Year ending Nov. 30, 1928	Total to Nov. 30, 1928
<b>GENERAL OVERHEAD:</b>		
Administration . . . . .	\$15,207.76	\$24,225.18
Engineering . . . . .	76,812.49	111,630.48
Total General Overhead . . . . .	\$92,020.25	\$135,855.66
<b>ENGINEERING:</b>		
Salaries, Engineering and Clerical . . . . .	\$74,472.02	\$128,482.07
Furniture and Fixtures . . . . .	-6,916.51	1,167.17
Engineering Instruments . . . . .	5,395.91 <sup>3</sup>	5,395.91
Rent and Upkeep . . . . .	378.53	609.17
Automobile Purchase . . . . .	6,056.96 <sup>4</sup>	6,056.96
Automobile Maintenance . . . . .	3,166.34	5,171.48
Contracts for Investigations and Surveys . . . . .	35,448.91 <sup>5</sup>	35,448.91
Office Buildings . . . . .	923.23	923.23
Miscellaneous Expense (undistributed) . . . . .	-36,775.40	2,149.74
Printing and Blueprinting . . . . .	526.04 <sup>1</sup>	526.04
Stationery and Office Supplies . . . . .	2,373.37 <sup>1</sup>	2,373.37
Postage . . . . .	203.36 <sup>1</sup>	203.36
Total Engineering . . . . .	\$85,252.76	\$188,507.41
<b>REAL ESTATE:</b>		
Legal and Expert Expense . . . . .	\$26,695.31	\$54,693.61
Labor . . . . .	56.10	56.10



	Year ending Nov. 30, 1928	Total to Nov. 30, 1928
<b>REAL ESTATE — <i>Concluded.</i></b>		
Miscellaneous Expense (undistributed)	\$222.10	\$763.25
Advertising	19.29	19.29
Stationery and Office Supplies	0.45	0.45
Purchases and Settlements	1,142,218.90	2,103,020.98
Taxes	9,984.20	14,351.51
Fire Protection, Equipment	1,817.43	1,817.43
Automobile Purchase	200.00	200.00
Automobile Maintenance	36.61	36.61
Miscellaneous Expense	14.36	14.36
Special Agents, Salaries	1,431.33	1,431.33
Equipment	118.33	118.33
Automobile Purchase	609.96	609.96
Automobile Maintenance	274.28	274.28
Miscellaneous Expense (undistributed)	165.91	165.91
Printing	41.60	41.60
Postage	1.42	1.42
Renting Agents, Salaries	2,155.43	2,155.43
Furniture and Fixtures	29.29	29.29
Miscellaneous Expense	14.04	14.04
<b>Total Real Estate</b>	<b>\$1,186,106.34</b>	<b>\$2,179,815.18</b>
<b>SWIFT RESERVOIR DAMAGES:</b>		
Consultant Expense	\$0.00	\$921.47
<b>Total Swift Reservoir Damages</b>	<b>\$0.00</b>	<b>\$921.47</b>
<b>SWIFT DIVERSION DAMAGES:</b>		
Salaries	\$3,011.86	\$3,011.86
Consultant Expense	0.00	1,360.54
Automobile Maintenance	1.25	1.25
Contracts for Investigations and Surveys	569.47	569.47
Miscellaneous Expense	696.25	2,065.46
<b>Total Swift Diversion Damages</b>	<b>\$4,278.83</b>	<b>\$7,008.58</b>
<b>CEMETERIES:</b>		
Labor	\$545.00	\$545.00
Materials	339.43	339.43
Purchases and Settlements	556.00	556.00
Transportation of Bodies	45.00	45.00
Transportation of Monuments	133.00	133.00
Miscellaneous Expense	51.81	51.81
<b>Total Cemeteries</b>	<b>\$1,670.24</b>	<b>\$1,670.24</b>
<b>PERMANENT CONSTRUCTION — EXCEPT CONSTRUCTION CONTRACTS:</b>		
Installed Equipment	\$214.78 <sup>1</sup>	\$214.78
Miscellaneous Expense	—214.78	0.00
<b>Total</b>	<b>\$0.00</b>	<b>\$214.78</b>
<b>Total Swift River Reservoir Division</b>	<b>\$1,369,328.42</b>	<b>\$2,513,993.32</b>
<b>SOUTHERN SUDBURY EMERGENCY SUPPLY</b>		
	Year ending Nov. 30, 1928	Total to Nov. 30, 1928
<b>GENERAL OVERHEAD:</b>		
Administration	\$1,322.84	\$8,645.13
Engineering	4,840.10	32,997.42
<b>Total General Overhead</b>	<b>\$6,162.94</b>	<b>\$41,642.55</b>

	Year ending Nov. 30, 1928	P.D. 147. Total to Nov. 30, 1928
<b>ENGINEERING:</b>		
Salaries . . . . .	\$6,889.83	\$33,222.97
Consultant Expense . . . . .	0.00	3,816.25
Furniture and Fixtures . . . . .	-4,909.91	30.70
Engineering Instruments . . . . .	216.06 <sup>3</sup>	216.06
Rent and Upkeep . . . . .	118.22	543.40
Automobile Purchase . . . . .	1,919.00 <sup>4</sup>	1,919.00
Automobile Maintenance . . . . .	536.24	1,514.45
Labor . . . . .	0.00	173.00
Miscellaneous Expense (undistributed) . . . . .	-564.52	1,298.52
Printing and Blueprinting . . . . .	215.33 <sup>1</sup>	215.33
Stationery and Office Supplies . . . . .	567.87 <sup>1</sup>	567.87
Postage . . . . .	52.80 <sup>1</sup>	52.80
Total Engineering . . . . .	\$5,040.92	\$43,570.35
<b>REAL ESTATE:</b>		
Legal and Expert Expense . . . . .	\$277.27	\$1,453.87
Consultant Expense . . . . .	86.87	116.87
Purchases and Settlements . . . . .	6,625.00	13,663.22
Total Real Estate . . . . .	\$6,989.14	\$15,233.96
<b>SOUTHERN SUDBURY DIVERSION DAMAGES:</b>		
Consultant Expense . . . . .	\$205.73	\$1,075.23
Settlements . . . . .	0.00	24,000.00
Total Southern Sudbury Diversion Damages . . . . .	\$205.73	\$25,075.23
<b>PERMANENT CONSTRUCTION — CONSTRUCTION CONTRACTS:</b>		
Contract No. 5, Cordaville Pipe Line . . . . .	\$9,081.13	\$83,262.86
Contract No. 6, Cordaville Pumping Station . . . . .	3,399.81	17,385.04
Contract No. 7, Hopkinton Pipe Line . . . . .	21,529.62	134,365.72
Contract No. 11, Ashland Pipe Line . . . . .	20,102.49	130,145.35
Contract No. 13, Whitehall Pipe Line . . . . .	17,472.71	60,603.17
Contract No. 16, Whitehall Open Channel . . . . .	26,456.09	32,695.16
Total Contracts . . . . .	\$98,041.85	\$458,457.30
<b>PERMANENT CONSTRUCTION — EXCEPT CONSTRUCTION CONTRACTS:</b>		
Installed Equipment . . . . .	\$7,960.11 <sup>1</sup>	\$7,960.11
Miscellaneous Expense . . . . .	-5,768.08	2,749.08
Labor . . . . .	1,011.00	1,011.00
Materials of Construction . . . . .	207.09	207.09
Total . . . . .	\$3,410.12	\$11,927.28
Total Southern Sudbury Emergency Supply . . . . .	\$119,850.70	\$595,906.67
<b>SUMMARY</b>		
Wachusett-Coldbrook Tunnel Division . . . . .	\$1,971,507.74	\$2,841,207.30
Coldbrook-Swift Tunnel Division . . . . .	43,544.80	70,719.17
Swift River Reservoir Division . . . . .	1,369,328.42	2,513,993.32
Southern Sudbury Emergency Supply . . . . .	119,850.70	595,906.67
Unassigned . . . . .	-505.17	1,068.81
Grand Total . . . . .	\$3,503,726.49	\$6,022,895.27



RECEIPTS FROM RENTS, SALES, ETC.

	Year ending Nov. 30, 1928	Total to Nov. 30, 1928
Receipts from Sales . . . . .	\$7,004.17	\$7,515.67
Receipts from Rents . . . . .	17,339.60	19,844.01
Miscellaneous Receipts . . . . .	31.29	51.48
<hr/>		<hr/>
Total Receipts . . . . .	\$24,375.06	\$27,411.16

<sup>1</sup> Includes expenditures prior to November 30, 1927, previously carried in other accounts.  
<sup>2</sup> Expenditures prior to November 30, 1927, included in the Miscellaneous Expense account.  
<sup>3</sup> Includes Engineering Instruments prior to November 30, 1927, which had been carried in the Furniture and Equipment account.  
<sup>4</sup> Includes Automobile Purchase prior to November 30, 1927, which had been listed under Furniture and Equipment.  
<sup>5</sup> Includes Contracts for Investigations and Surveys prior to November 30, 1927, which had been carried in the Miscellaneous Expense account.  
<sup>6</sup> Part of purchase price.





COMMONWEALTH OF MASSACHUSETTS  
METR. DISTR. WATER SUPPLY COMMISSION  
MONTHLY PROGRESS - REAL ESTATE NEGOTIATIONS FOR  
SWIFT RIVER RESERVOIR

DATE	OWNERS' OFFERS TO SELL TO COMMONWEALTH		TITLE VESTED IN COMMONWEALTH (Acres)
	NUMBER OF OFFERS	TOTAL AREA (Acres)	AREA NOT REQUIRED (Acres)
1927			
December	31	793	9
1928			
January	25	1386	140
February	25	1327	0
March	30	1053	0
April	21	769	103
May	37	1083	75
June	55	1656	115
July	41	1598	251
August	48	1302	1071
September	52	1837	336
October	61	1696	74
November	44	3417	843
Total for Year ending Nov. 30, 1928.	470	17917	3017
Total to Nov. 30, 1927.	740	32202	2468
Total to Nov. 30, 1928.	1210	50119	5485
Options Outstanding Nov. 30, 1928 - 3357 Acres.			
Acreage is based upon estimates obtained from deeds or other information and not from surveys.			





COMMONWEALTH OF MASSACHUSETTS  
METR. DISTR. WATER SUPPLY COMMISSION

LOCATION OF REAL ESTATE ACQUIRED FOR THE SWIFT  
RIVER RESERVOIR

TOWNS	TITLE VESTED IN COMMONWEALTH (Acres)	
<i>Belchertown</i>	<i>1095</i>	
<i>Dana</i>	<i>2189</i>	
<i>Enfield</i>	<i>5000</i>	
<i>Greenwich</i>	<i>4685</i>	
<i>Hardwick</i>	<i>556</i>	
<i>New Salem</i>	<i>2453</i>	
<i>Pelham</i>	<i>1149</i>	
<i>Petersham</i>	<i>352</i>	
<i>Prescott</i>	<i>5730</i>	
<i>Shutesbury</i>	<i>133</i>	
<i>Ware</i>	<i>254</i>	
<i>Wendell</i>	<i>1</i>	
<i>Total Dec. 1, 1928</i>	<i>23,597</i>	

*Acres is based upon estimates obtained from deeds or other information and not from surveys.*





COMMONWEALTH OF MASSACHUSETTS  
METR. DISTR. WATER SUPPLY COMMISSION  
REAL ESTATE TAKINGS

TAKING FOR	TAK- ING NO.	LOCATION	PLAN NO.	DATE OF TAKING	TITLE VESTED IN COMMONWEALTH	
					FEE (Acres)	EASEMENT (Acres)
Wachusett - Coldbrook Tunnel	1	Holden	T-1 to T-5 incl.	July 22, 1927	186.01	3.91
Wachusett - Coldbrook Tunnel	2	Rutland			1.86	
Wachusett - Coldbrook Tunnel	3	Rutland	T-6 to T-12 incl.	Aug. 26, 1927	90.90	8.92
Wachusett - Coldbrook Tunnel	3	Oakham			6.62	2.00
Wachusett - Coldbrook Tunnel	3	Oakham	T-13	Nov. 11, 1927	103.58	
Wachusett - Coldbrook Tunnel	4	Barre			181.25	0.84
Wachusett - Coldbrook Tunnel	4	West Boylston	T-1 A	Aug. 21, 1928		2.57
Wachusett - Coldbrook Tunnel	4	Holden				<u>2.13</u>
* Ashland Pipe Line	1	Southborough	C-1 & C-2	July 8, 1928	570.22	20.37
Ashland Pipe Line	2	Ashland				0.85
Ashland Pipe Line	2	Ashland	C-8 to C-11 incl.	Nov. 11, 1927		4.48
Cordaville Pipe Line	3	Framingham				9.13
Hopkinton Pipe Line	4	Southborough	C-3 to C-7 incl.	July 8, 1928	1.14	1.34
Hopkinton Pipe Line	4	Hopkinton	C-12 to C-14 incl.	Oct. 14, 1928	64.17	8.75
Indian Brook	5	Ashland & Hopkinton	No Plan	Sept. 2, 1927	65.31	<u>4.47</u>
Cold Spring Brook	6	Ashland	No Plan	Jan. 6, 1928		<u>29.02</u>
Sudbury River	7	Southborough, Hopkin- ton, & Westborough	No Plan	Jan. 6, 1928		
City Brook	8	Hopkinton	No Plan	Jan. 6, 1928		Water Diversion

\* Recorded in both Worcester and Middlesex Counties. All others in Worcester County.





COMMONWEALTH OF MASSACHUSETTS  
METR. DISTR. WATER SUPPLY COMMISSION  
**TOTAL VALUE OF WORK ACCOMPLISHED UNDER CONTRACTS  
IN PROGRESS DURING YEAR ENDING NOV. 30, 1928**

CONTRACT NUMBER	①	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	⑯	⑰
CONTRACTOR	PENNSYLVANIA DRILLING CO.	J.J. COUGHLAN & SONS, INC.	LOCKJOINT PIPE CO.	F.A. MAZZUR CO., INC.	CENEDELLA & CO.	J.J. COUGHLAN & SONS, INC.	FAIRCHILD AERIAL SURVEYS, INC.	NEW ENGLAND POWER CO.	ANTONIO MOGAVERO.	DRAVO CONT. CO.	PORTLAND CONT. CO., INC.	WEST CONST. Co. (ASSIGNEE)	MARLBOROUGH ELECTRIC CO.	SANDERS ENG. CO.	WEST CONST. Co. (ASSIGNEE)
BASIS OF AWARD	SUPPLEMENTARY AGREEMENT	137,854.80	78,818.00	16,357.00	126,550.00	162,125.00	MATERIAL ONLY 590.00	OPERATION AND MAINTENANCE	125,150.00	259,800.00	54,963.00	* 4,074,981.25		36,720.00	** 4,799,362.50
DECEMBER 1927	12,831.65	127,407.80	82,424.15	16,193.43	134,365.72	176,113.90	52.50	3,235.42	126,435.09	254,071.65	54,270.51		22.57	27,095.60	
JANUARY 1928		144,531.40	82,424.15	17,172.67		218,405.30	52.50	4,167.21	129,475.23	288,073.82	60,369.38		39.86	31,731.60	
FEBRUARY		176,850.40	82,424.15	17,172.67		277,908.50	60.00	4,880.03	129,475.23	344,789.63	60,369.38		104.65	32,497.40	
MARCH		206,600.80	82,424.15	17,172.67		333,542.35		5,494.27	129,475.23	413,835.48	60,369.38		166.82	32,497.40	
APRIL		247,608.10	83,762.86	17,172.67		400,888.15		6,287.74	129,475.23	502,613.78	60,369.38		211.85	32,497.40	
MAY		264,939.10		17,385.04		432,298.60		7,004.33	129,475.23	581,371.59	60,369.38		251.49	32,497.40	4,994.00
JUNE		*** 290,581.99				*** 456,784.26		7,639.90	129,475.23	*** 632,727.44	60,603.17	6,832.45	270.09	32,497.40	17,986.20
JULY								8,352.11	129,475.23			6,832.45		32,695.16	17,986.20
AUGUST								9,007.58	129,475.23			34,633.35			36,731.54
SEPTEMBER								9,662.33	130,145.35			73,332.32			253,512.64
OCTOBER								10,361.68				152,425.85			334,996.64
NOVEMBER 1928								11,066.73				268,500.15			491,603.64

\* Portion of work completed under contract 12 before contract 14 was executed reduces this amount by about 7%

\*\* Portion of work completed under contracts 4 and 8 before contract 17 was executed reduces this amount by about 7%

\*\*\* Includes construction beyond that contemplated when proposal was accepted.



COT

Year	Month	Day	Time	Location	Remarks
1900	Jan	1	10:00	St. Paul	Arrived
1900	Jan	2	10:00	St. Paul	Left
1900	Jan	3	10:00	St. Paul	Arrived
1900	Jan	4	10:00	St. Paul	Left
1900	Jan	5	10:00	St. Paul	Arrived
1900	Jan	6	10:00	St. Paul	Left
1900	Jan	7	10:00	St. Paul	Arrived
1900	Jan	8	10:00	St. Paul	Left
1900	Jan	9	10:00	St. Paul	Arrived
1900	Jan	10	10:00	St. Paul	Left
1900	Jan	11	10:00	St. Paul	Arrived
1900	Jan	12	10:00	St. Paul	Left
1900	Jan	13	10:00	St. Paul	Arrived
1900	Jan	14	10:00	St. Paul	Left
1900	Jan	15	10:00	St. Paul	Arrived
1900	Jan	16	10:00	St. Paul	Left
1900	Jan	17	10:00	St. Paul	Arrived
1900	Jan	18	10:00	St. Paul	Left
1900	Jan	19	10:00	St. Paul	Arrived
1900	Jan	20	10:00	St. Paul	Left
1900	Jan	21	10:00	St. Paul	Arrived
1900	Jan	22	10:00	St. Paul	Left
1900	Jan	23	10:00	St. Paul	Arrived
1900	Jan	24	10:00	St. Paul	Left
1900	Jan	25	10:00	St. Paul	Arrived
1900	Jan	26	10:00	St. Paul	Left
1900	Jan	27	10:00	St. Paul	Arrived
1900	Jan	28	10:00	St. Paul	Left
1900	Jan	29	10:00	St. Paul	Arrived
1900	Jan	30	10:00	St. Paul	Left
1900	Jan	31	10:00	St. Paul	Arrived



COMMONWEALTH OF MASSACHUSETTS  
METR. DISTR. WATER SUPPLY COMMISSION  
TABULATION OF BIDS FOR CONTRACT 14 FOR THE  
CONSTRUCTION OF WACHUSETT-COLDBROOK TUNNEL

[illegible]

\* Proposal A is for entire tunnel.

xx " B " " East portion.

† The Dravo Contracting Co. will con

\* Contract executed as Contract 14 April 30, 1928

★ ★ Contract executed as Contract 17 April 30, 19



No.		Date		Description		Amount	
1		1880	Jan 1	Balance		100.00	
2		1880	Jan 15	Received from A. B.		50.00	
3		1880	Feb 1	Received from C. D.		25.00	
4		1880	Mar 1	Received from E. F.		75.00	
5		1880	Apr 1	Received from G. H.		100.00	
6		1880	May 1	Received from I. J.		150.00	
7		1880	Jun 1	Received from K. L.		200.00	
8		1880	Jul 1	Received from M. N.		250.00	
9		1880	Aug 1	Received from O. P.		300.00	
10		1880	Sep 1	Received from Q. R.		350.00	
11		1880	Oct 1	Received from S. T.		400.00	
12		1880	Nov 1	Received from U. V.		450.00	
13		1880	Dec 1	Received from W. X.		500.00	
14		1880	Dec 31	Balance		2500.00	
15		1881	Jan 1	Balance		2500.00	
16		1881	Jan 15	Received from Y. Z.		100.00	
17		1881	Feb 1	Received from A. B.		200.00	
18		1881	Mar 1	Received from C. D.		300.00	
19		1881	Apr 1	Received from E. F.		400.00	
20		1881	May 1	Received from G. H.		500.00	
21		1881	Jun 1	Received from I. J.		600.00	
22		1881	Jul 1	Received from K. L.		700.00	
23		1881	Aug 1	Received from M. N.		800.00	
24		1881	Sep 1	Received from O. P.		900.00	
25		1881	Oct 1	Received from Q. R.		1000.00	
26		1881	Nov 1	Received from S. T.		1100.00	
27		1881	Dec 1	Received from U. V.		1200.00	
28		1881	Dec 31	Balance		12000.00	





